SMALL HYDRO FEASIBILITY

FOR ESPERANZA, B.C.

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Prepared for:

Nootka Mission Association
Esperanza via Tahsis, B.C.

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EXECUTIVE SUMMARY

The Nootka Mission Association (NMA) is the registered, non-profit society which administers the community of Esperanza. This remote settlement of about 42 permanent residents is located on the northwest coast of Vancouver Island.

This study is directed primarily to the board of NMA and an effort has been made to present the material clearly and in a manner that can be understood by a non-technical individual. This is particularly important when a significant amount of self-development is anticipated, as is the case here.

Esperanza relies on a 50 Kw diesel plant to produce all of its electricity. Fuel costs are the single largest operating expense. This was reported as $29,117. in 1982.

The objective of this study in its broadest terms is to identify and assess the various options available to reduce the energy consumption of the community and, particularly, to reduce the use of oil. After a preliminary site investigation it was apparent that small hydro and energy conservation clearly represented the most attractive alternatives.

A detailed community survey was conducted of the electrical loads, building construction, usage patterns, level of energy management and types of fuels used. The results indicated substantial energy savings could be achieved in several areas. The most significant of these were hot water tank insulation, home insulation (CHIP funding available), propane conversion for heating domestic hot water and clothes dryers. Several of these demonstrated a simple return on investment of about one year.

Lutes Creek and Cover Creek were identified as offering a significant opportunity for small hydro development. The steps for assessment included 1) stream gaging to develop an adequate hydrological model, 2) site survey to determine the site development plan, 3) survey of existing and anticipated loads, 4) preliminary engineering to develop costs and 5) financial analysis. Each of these steps was conducted for both Lutes and Cover Creek.

The most attractive scale for development of Lutes small hydro was 100 kw peak (both streams are seasonal and power output will vary) at a capital requirement of $198,035. This assumes Esperanza provides most of the labour. The financial

analysis demonstrated that the average cost of power (in 1984 dollars), over the 24 year project life, would range from 2.3 to 4.2 cents per Kw-hr. This compares favourably to 19.4 cents per Kw-hr for the existing 50 kw diesel system assessed over the equivalent life.

The most attractive scale for development of Cover Creek was 65 Kw peak. The hydrological study determined that this site would not develop significant power for 50% of the year due to low stream flows in the dryer months from its small watershed. The capital requirement was estimated at $77,562. and the cost per Kw-hr over the 24 year project life was 9.7 to 11.0 cents per Kw-hr. This was higher than Lutes because of the need for large amounts of supplementary diesel power.

It was recommended that the Nootka Mission Association commence immediately to pursue the various options for raising the funds to develop the proposed Lutes Creek small hydro site. If, after two years, the financing for Lutes is still incomplete Cover Creek should be carefully considered for development together with an aggressive program to cut peak power requirements.

ETUDE DE FAISABILITE D'UNE PETITE CENTRALE HYDRO-ELECTRIQUE POUR ESPERANZA (C.-B.)

Résumé

La Nootka Mission Association est une société enregistrée sans but lucratif qui administre la collectivité d'Esperanza d'environ 42 résidents permanents située dans un endroit reculé sur la côte nord-ouest de l'Île de Vancouver.

La présente étude s'adresse principalement au conseil d'administration de l'Association; on y a donc pris soin de présenter le contenu clairement et en des termes qu'une personne sans formation technique peut comprendre. C'est important particulièrement lorsque les intéressés eux-mêmes exécuteraient une proportion importante des travaux de mise en valeur, comme dans le cas actuel.

Esperanza compte sur un groupe électrogène diesel de 50 kW pour produire toute l'électricité consommée par la collectivité. Le coût du combustible - 29 117 $ en 1982 - représente le poste le plus important des frais d'exploitation.

L'objectif global de l'étude consiste à déterminer et à évaluer les différentes options disponibles pour réduire la consommation d'énergie de la collectivité et plus particulièrement pour réduire la consommation de pétrole. Après une investigation préliminaire sur les lieux, il a été constaté que l'option comportant l'aménagement d'une petite centrale hydro-électrique et l'application de mesures d'économie d'énergie représente la solution la plus intéressante.

Une enquête détaillée a été menée dans la collectivité pour déterminer les charges électriques, les types de bâtiments, la structure de la consommation, le degré de gestion énergétique et les genres de combustibles utilisés. Les résultats indiquent qu'il existe des possibilités de faire des économies sensibles dans un certain nombre de domaines, dont les plus importantes sont: l'isolation des réservoirs d'eau chaude, l'isolation thermique des habitations (des fonds du PITRC sont disponibles), la conversion au propane du chauffage de l'eau domestique et des sécheuses à linge. Dans plusieurs cas, il suffirait d'un an environ pour récupérer les investissements nécessaires.

Les ruisseaux Lutes et Cover offrent un potentiel intéressant pour l'aménagement de petites centrales hydro-électriques. L'évaluation menée dans les deux cas comprend les étapes suivantes: 1) mesure des débits pour élaborer un modèle hydrologique adéquant, 2) examen des sites pour déterminer le plan d'implantation, 3) estimation des charges actuelles et prévues, 4) étude technique préliminaire pour calculer les coûts et 5) analyse financière.

Pour le ruisseau Lutes, l'échelle d'aménagement la plus intéressante se situe à une puissance de pointe de 100 kW (le débit des deux ruisseaux subit des variations saisonnières et la puissance va varier). Le coût en capital s'élèverait à 198 035 $, à condition que la majeure partie de la main-d'oeuvre soit fournie par Esperanza. Selon l'analyse financière, le coût moyen du kilowatt-heure (en dollars de 1984) se situerait entre 2,4 et 4,2 cents pour la durée de vie prévue de 24 ans du projet. Le coût unitaire du système existant diesel de 50 kW, calculé pour une durée de vie équivalente, est de 19,4 cents le kilowatt-heure.

Dans le cas du ruisseau Cover, la puissance de pointe la plus intéressante serait de 65 kW. L'étude hydrologique indique que le site ne se prête pas à la production d'électricité en quantité suffisante pendant 50% de l'année en raison de la faiblesse du débit pendant les mois secs, étant donné la dimension réduite du bassin versant. Il faudrait un investissement de 77 562 $; pour la durée de vie de 24 ans du projet, le kilowatt-heure coûterait entre 9,7 et 11,0 cents. Le coût du kilowatt-heure est plus élevé que dans le cas du ruisseau Lutes parce qu'il faut prévoir des apports plus importants d'électricité produite par le groupe électrogène diesel.

Il est recommandé que la Nootka Mission Association commence immédiatement à poursuivre les différentes options pour réunir les fonds nécessaires à la mise en valeur du potentiel hydro-électrique du site proposé du ruisseau Lutes. Si après deux ans, l'Association n'a toujours pas réussi à réunir assez de fonds pour l'aménagement du ruisseau Lutes, il faudra examiner soigneusement l'option de mettre en valeur le ruisseau Cover et de lancer un programme dynamique destiné à réduire la consommation d'électricité aux heures de pointe.

Cette étude a été effectuée par Solace Energy Centres Inc. pour la Nootka Mission Association, à l'aide d'une subvention du Programme de démonstration dans les collectivités éloignées d'Energie, Mines et Ressources Canada.

1.0 AUTHORITY

This report has been prepared by Micro Power Engineering, a division of Solace Energy Centres Inc. under the authorization of the board of the Nootka Mission Association (NMA), a registered Canadian charitable society. Financial assistance for the study was provided by Energy, Mines and Resources Canada through the auspices of the Remote Community Demonstration Program (RCDP). The fundamental objectives of the RCDP program have been stated as the demonstration of oil reduction or displacement technologies and measures which will improve the quality, price, or security of energy supply in remote communities. These objectives constitute the broad basis of this study.

2.0 COMMUNITY PROFILE

2.1 LOCATION AND ACCESS

The Nootka Mission Association is the administrative body having jurisdiction over the community of Esperanza. Esperanza is located at 126 degrees 45' W longitude and 49 degrees 53' N lattitude on Hecate Channel on the northwest coast of Vancouver Island (see location map Fig. 2-1). The closest townsite is Tahsis which is 12 km northeast of Esperanza. Access to the community is by secondary road to Tahsis and then by water. Nootka Air will stop at Esperanza on their daily runs to Tahsis from Gold River and Campbell River.

2.2 HISTORY

NMA established the community of Esperanza in 1937 to provide a variety of social services to the coastal region roughly bounded by Ucluelet on the south and Kyuquot on the north. There was a regional hospital operated by NMA on the site until 1973. Other services have included the following: marine fuel dock, boatways, an optical/dental clinic, summer family and children's camping program, residences and a school for native peoples.

2.3 POPULATION

The community is composed of both native and non-native residents. The non-native sector is the largest contingent. There are 42 permanent residents (March 1983) and the population in the summer typically reaches 75.

FIGURE 2-1 LOCATION MAP

2.4 ECONOMIC ACTIVITY

NMA presently operates a marine fuel dock. The dental clinic is opened on an intermittent basis during the year. The summer camping program attracts about 300 campers each year. NMA is an independent registered non-profit society and as such receives financial support from various churches, foundations and individuals. Several of these support groups organize volunteer short-term work crews to undertake a broad range of improvement projects each year. NMA owns most of the land within the community and has a 25 year lease, with 20 years remaining on the rest of the property within the community. A few of the residents are employed by the local forest industry. Presently there are 3 or 4 native families living at Esperanza who are supported by Indian Affairs.

2.5 COMMUNITY SITE PLAN

Figure 2-2 depicts the physical layout of the community. The residences are single family dwellings except for buildings no. C-1 and C-2 which have dormitory style accomodation. The buildings are typically very old wood frame structures on shallow block foundations. There are 12 single family, 2 multi-purpose, and 3 industrial buildings.

2.6 PRESENT ENERGY USAGE

2.6.1 ELECTRICITY

Two diesel generating plants rated at 156 KVA and 62.5 KVA are the sole source of electricity at Esperanza. Historically, the 62.5 KVA powerplant has been used in the warmer months and the larger plant in the colder months. Originally, several of the buildings were heated electrically. By gradually converting virtually all of the buildings to wood heat and by carefully scheduling their loads, the community has recently managed to get by with only the 62.5 KVA unit year round.

In the warmer months the plant is operated from 6 AM to 1 PM and from 4:30 PM to 6:30 PM. In the cooler months the plant is operated from 6 AM to 12:30 PM and from 3:30 PM to 10 PM. In this way the 62.5 KVA unit is kept almost fully loaded when it is operated. Fuel costs with the diesel system operating in this fashion were reported at $29,117. for 1982.

ESPERANZA, BRITISH COLUMBIA

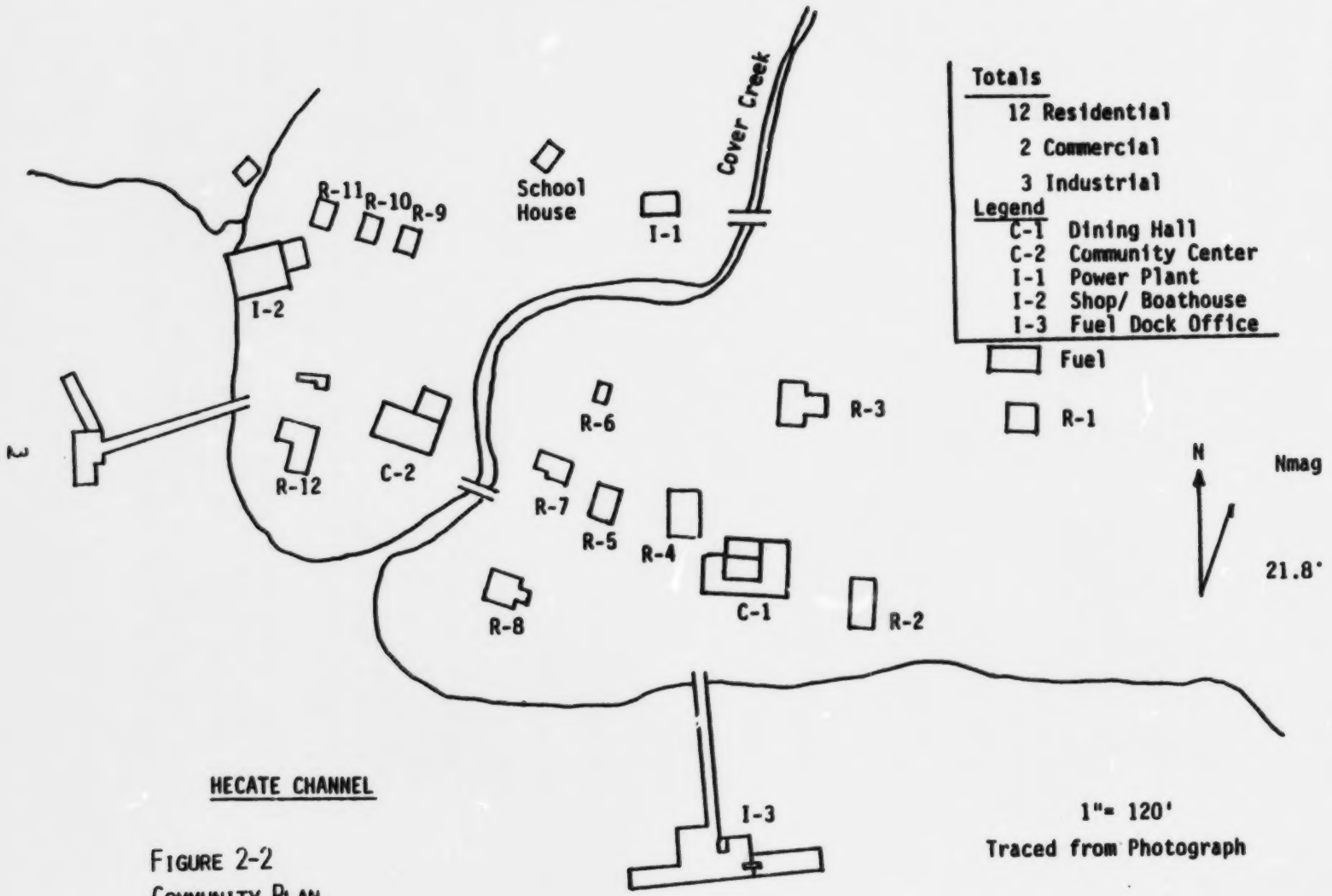

FIGURE 2-2
COMMUNITY PLAN

2.6.2 HEATING OIL

Heating oil is used for space heat in only one of the residences and in building C-1 for forced air space heat and for domestic hot water. The oil consumption figures for these have not been reported but are known to be insignificant with respect to the amount of diesel fuel consumed.

2.6.3 PROPANE

Propane is in limited use in the community. There are 2 propane clothes dryers, a propane demand domestic hot water heater and propane is used for cooking. Propane is available in bottles from Tahsis. There is presently no marine propane barge service in the area.

2.6.4 WOOD

Wood is used as a fuel only for space heating. There are air-tight heaters in every building except for two of the residences, the shop and building C-1. Two of the heaters are wood furnaces. The wood is obtained either from windfall trees or salvage logs found adrift in Hecate Channel.

3.0 SCOPE OF WORK

3.1 GENERAL OBJECTIVES

The objective of this study, stated in its most general terms, is to identify the cost-effective opportunities that exist which will significantly reduce the use of oil for power generation.

Diesel fuel costs alone were reported at $29,117 in 1982. This represents the single largest operating expense for the community. Approximately 95% of this expense is related to power generation with the remainder attributable to space heating.

3.2 ALTERNATIVES FOR OIL REDUCTION

This section briefly summarizes the site conditions as they relate to the potential application of various alternative technologies for reducing oil usage.

a. Solar:
There is one significant obstacle to the application of any kind of solar technology at this site. In the 12 months of 1983 there were 215 days with recorded precipitation. The 20 year median average rainfall for the region is 3977 millimeters (mm). Furthermore, the greatest frequency of cloud cover occurs during the cooler months when solar would be most beneficial. For these reasons solar was ruled out as an economically viable alternative at a very preliminary stage.

b. Wind Power:
The west coast of Vancouver Island is characterized by a relatively high average monthly windspeed. However, local topographical conditions at Esperanza have created an area which is quite sheltered. It is likely that this was a significant factor in the original choice of this site for the community.

c. Biomass:
There exists an ample supply of firewood at the site relative to the needs of the community. There is no supply of wood wastes or other form of biomass. Of the buildings on the site only two do not have wood space heat. The potential for improving the quality of the wood, the effectiveness of the woodheat systems and expansion of their application to include domestic hot water preheating will be considered.

d. Small Hydro
Two streams were identified that offer a significant opportunity for small hydro development. Cover Creek is a water shed of 1.2 sq. km. which flows directly through Esperanza and empties into Hecate Channel. Lutes Creek is a watershed of 11.5 sq. km. located 3.3 km west of the community and also emptying into Hecate Channel. These two sites will be examined in detail to identify the technical feasibility, the reliability of the resource, and the financial attractiveness of development. These resources were identified at a very preliminary stage as providing the most significant opportunity for displacing the diesel fuel used for power generation.

e. Energy Conservation
The general level of energy conservation in the buildings at Esperanza is very poor. The expense of upgrading must be weighed against the fact that the wood resource for space heating is essentially free. Savings will impact principally the area of lifestyle in that fewer man-hours will be required for the handling of wood. The decision will be very subjective. Nonetheless, the opportunities and relative costs for energy conservation measures will be determined.

f. Grid Extension
The B.C. Hydro electrical power grid extends as far as Tahsis and is just now being linked to Zeballos. Tahsis would be the most likely point for grid extension to Esperanza. The only other residents between Esperanza and Tahsis are at CeePeeCee, and presently there is only one family there. The community has inquired of the cost to bring the grid in to Esperanza. Andy Moja of the B.C. Hydro Distribution Engineering Division estimated that such a line would likely cost more than $1 million.

4.0 SMALL HYDRO FEASIBILITY

4.1 OVERALL APPROACH TO ASSESSMENT

The normal steps for assessing the feasibility of a proposed small hydro development are as follows: 1) hydrological study, 2) site survey to identify the development plan, 3) survey of existing and anticipated electrical loads, 4) preliminary engineering to permit estimation of major cost components and 5) finanical analysis. Steps 1, 3 and 5 will be evaluated in the context of both streams as they share a good deal of common material. The remaining topics will receive independent consideration for each of the two streams of interest.

4.2 ELECTRICAL SYSTEM EVALUATION

The layout of the existing 3 phase 120/208 volt distribution centre, located in the existing diesel powerhouse (bldg. I-1), is illustrated in Figure 4-1. This system was completely upgraded about 5 years ago and is in excellent condition. The load carrying capacity of the existing system is limited by the permissible ampacities (maximum current approved) of the four underground transmission cables out of the four sub-distribution disconnects in the powerhouse. Presently, the system capacity is about 116 kw at a .8 power factor.

A listing of the existing electrical loads by type, power demand and location is summarized in Table 4-1. This Table also presents an analysis of this information based on typical residential load patterns.and details the per cent of total energy and the total Kw-hr per year by type of load.

There are two existing diesel powerplants - a 156 KVA Garner and a 62 KVA Isuzu. Both appear to be well maintained and the facility generally has been kept in excellent condition. The Gardner was totally rebuilt in 1981 at a cost of $17,000. The Isuzu is a completely reconditioned unit purchased in 1982.

The community has gradually trimmed its peak power requirements so that the 62 KVA unit running an average 12 hours per day can meet their requirements year round. The larger unit is now used only for emergency stand-by. The 62 kva unit seldom is running under 40 kw and is often at the threshold of its capacity. This is a remarkable achievement. It is apparent that the community is barely managing with the smaller generator under the existing

TABLE 4-1 SURVEY AND ANALYSIS OF EXISTING ELECTRICAL LOADS

BUILDING NO.	LIGHTING FLUORESCENT	LIGHTING INCANDESCENT	DOMESTIC HOT WATER	LAUNDRY WASHER	LAUNDRY DRYER	SPACE HEAT	FRIDGES	FREEZERS	MISCELLANEOUS POWER	RESPECTIVE ITEMS	BUILDING LOAD	% OF TOTAL
C-2	.80	3.33	9.0	1.6	16.3	(3.)	.573	.36	.4	FURNACE BLOWER MOTOR	32.(3)	19.
C-1	1.52	1.60	6.0				1.72	.72	2.5,13,1.5	TOASTER,AIR-CONDITIONER, DISHWASHER	27.2	16.5
I-2	1.20					(9.)			(16.8)	WELDER, MISC POWER TOOLS	1.2(25)	1.
R-12	.08	.72	6.0			(24.)	.573				6.9(24)	4.
1-3	.08	.46									.6	.5
School	.40	.60	3.0								4.0	2.5
I-1	.64										.6	.5
R-11		.36	3.0				.573				4.0	2.5
R-10		.36	3.0				.573				4.0	2.5
R-9		.36	3.0			(4.)	.573				3.5(4)	2.0
R-7		.72	3.0				.573				4.4	2.5
R-5		.72	4.0	.80	4.6		.573				10.6	6.0
R-4		.30	4.5	.80			.573				6.2	3.5
R-6		.12				6.					6.1	3.5
R-8		.66	6.0	.80			.573				8.0	4.5
R-2	.40	.72	6.0	.80	6.0		.573	.36	1.2	DISHWASHER	15.6	9.0
R-3	.17	.54	9.0	.80		(16.)	.573		12.	RANGE	22.6(16)	14.5
R-1		.48		.80	4.6		.573	.36	1.2	DISHWASHER	8.2	5.
Outdoor		.50									.5	.5
TOTALS	4.93	12.55	62.5	6.4	31.5	(58) 6	8.6	1.8	(16.8) 31.8		166. (72)	100.
ESTIMATED AVG. MONTHLY KW-HRS	4200.		8000.	40.	609.	2100.	1350.	1250.	310.		17859.	
% OF TOTAL ANNUAL KW-HRS	23.5		45.	3.5		12.	7.5	7.0	1.5		100.	

Note: ( ) INDICATES A LOAD NOT PRESENTLY IN USE

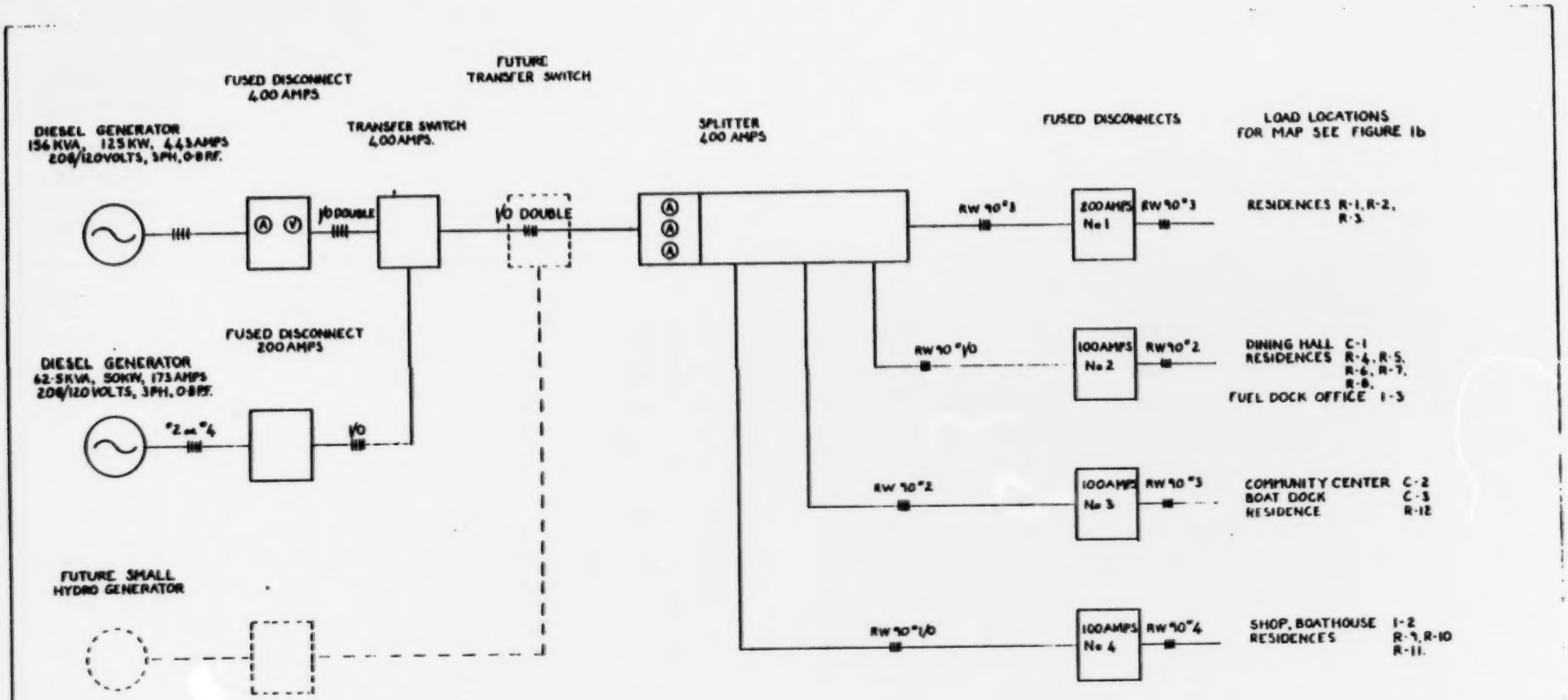

FIGURE 4-1
EXISTING COMMUNITY ELECTRICAL DISTRIBUTION

			MICRO POWER ENGINEERING
		PROJECT:	NOOTKA MISSION R.C.D.P. FEASIBILITY STUDY
		TITLE:	EXISTING POWER DISTRIBUTION SYSTEM
		DATE: 84 5 23	BY: G.F.
		SCALE: NONE	8311-A2-201

circumstances. If the larger unit is run at only 60 % of its capacity it will consume 50% more fuel per Kw-hr when compared with the smaller diesel.

4.3 HYDROLOGY OF COVER AND LUTES CREEKS

4.3.1 CHARACTER OF THE WATERSHEDS

The watersheds of Cover Creek and Lutes Creek are outlined in Figure 4-2. It was noted that the 50,000:1 topographical maps were in error by + and - 40% in indicating the rise over the first 1500 ft for both Lutes and Cover Creeks (40% high for Lutes and 40% low for Cover).

Approximately 50% of these watersheds have been logged in the past. Cover Creek was logged more than 50 years ago and Lutes Creek more than 20 years ago.

These watersheds have very similar geologies. Both consist principally of shallow fine granular and gravelled soils overlying bedrock. Bedrock outcroppings are frequent. Lutes Creek has a grade of less than 5% over 80% of its total length of 7 km. The steepest portion is the first kilometer which averages a 15% grade. The slopes of the watershed are, in contrast, very steep. Cover Creek and its watershed are both very steep with virtually no areas of shallow grade and an average grade of 20% grade along the stream.

Neither watershed has any significant area of marsh or pondage, and neither any snow pack that would persist much more than a week. The 18 year average indicates only 11 days of snowfall annually with average temperatures for the coldest month, January, of just over 40 degrees Fahrenheit.

4.3.2 METHODOLOGY

Due to the small scale of the watersheds and the total absence of data for any remotely similar watershed on any scale, it was decided that installation of a gaging weir on Cover Creek was critical. A laboratory callibrated 90 degree V notch weir was installed in March of 1983. It was noted that because of the well gravelled nature of the streambed that the flow reduced noticeably at certain locations along the stream, as portions of it became sub-surface flow. For this reason it was important to site the weir near the location of the proposed intake so a representative flow would be obtained.

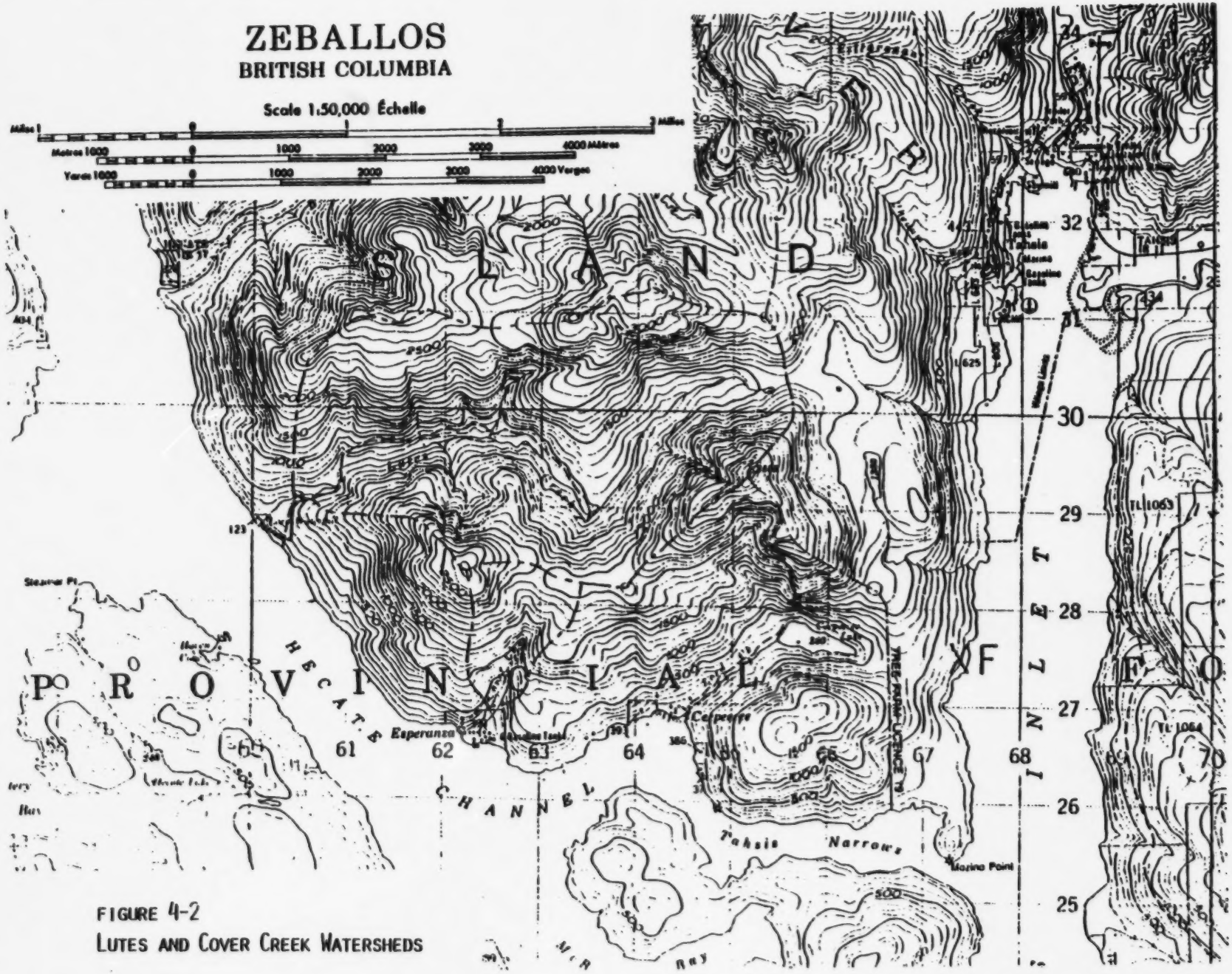

FIGURE 4-2
LUTES AND COVER CREEK WATERSHEDS

4.3.3 OBSERVATIONS AND CONCLUSIONS - COVER CREEK

Weir flow records were maintained for periods of 1983 for the months of March, April, May, July, August, September and November. This data is reported in Tables A-1 AND A-2 of the appendix.

From rain gauge measurements at Esperanza it was determined that there was a good correspondence to the precipitation recorded at Tahsis, particularly during the periods of sustained rainfall. The Tahsis data has been logged daily since 1952. The statistical summary of this data is reported in Table A-3 of the apppendix. A graphical representation of the monthly variations in the percentiles is shown in Fig 4-3.

The precipitation data from Tahsis was correlated to the stream flows measured on Cover Creek. The correlation is shown in Figures 4-4, 4-5 and 4-6. This flow data was interpreted graphically by three flow duration curves shown in Fig. 4-7. Curve 1 is derived from the November data, Curve 2 from the March/April data and Curve 3 from the data for May. The shape of these curves summarizes very well the major conclusion with respect to the hydrology of this stream. The increasing steepness of the curve at the high flow rates and the relatively low flows where the curves flatten out indicate that there is very little ground water retention in the watershed. The higher flowrates will be sustained only during the periods of heavy rainfall and will quickly recede a few days after the rainfall.

The primary objective of the hydrological study is to determine the percentage of time that a given flow will occur. Utilizing the shape of the three curves of Figure 4-7 as models representative of periods of low flow, moderate flow and high flow, allowed the development of Figure 4-8. The data for this was generated by interpolating between these three curves to identify the other transitional curves. These curves could then be identified with an estimated monthly precipitation using the actual precipitation totals for the three original curves. This interpretive method allowed the development of flow-duration data from the historical statistical precipitation information for Tahsis.

4.3.4 HYDROLOGY OF LUTES CREEK

Monitoring of the daily changes in stream level in Lutes Creek indicated that it followed very closely the pattern of Cover Creek. It was apparent that even though the size of

FIGURE 4-3
TAHSIS MONTHLY AVE. RAINFALL DATA
OVER 28 YEARS (1951-1980)

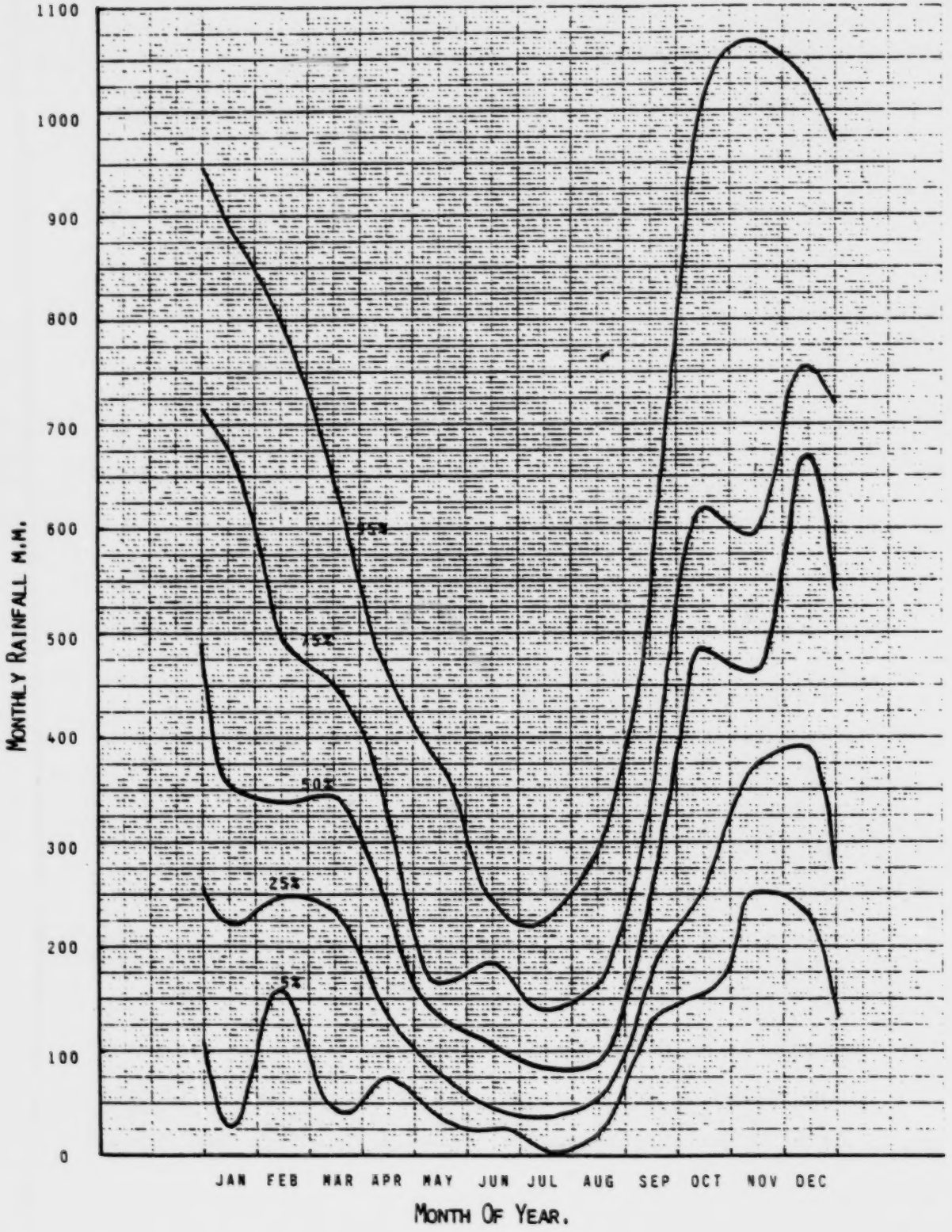

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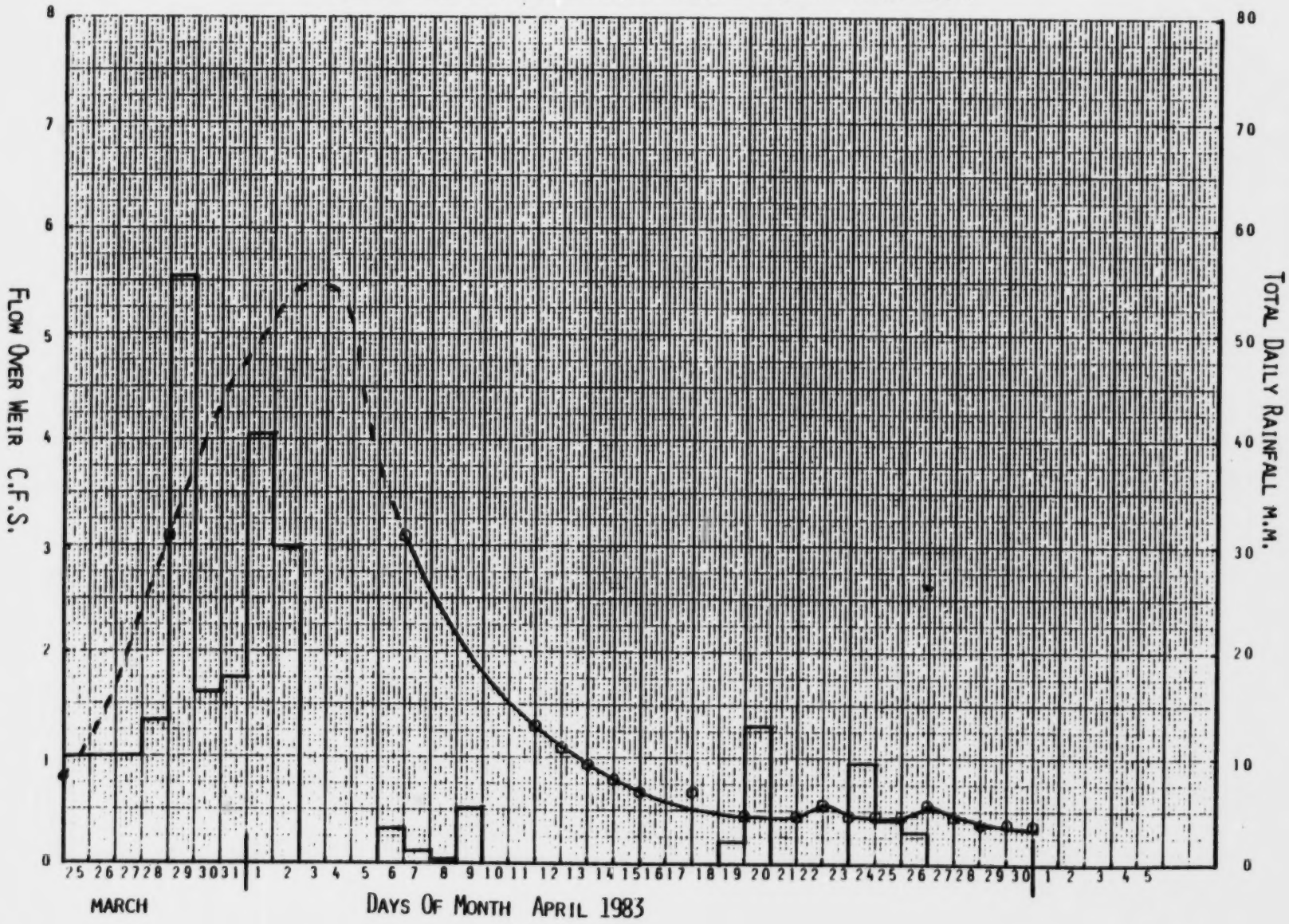
FIGURE 4-4 PLOT OF FLOW DOWN COVER CREEK AT WEIR AND AREA PRECIPITATION AGAINST DAYS OF MARCH - APRIL 1983.



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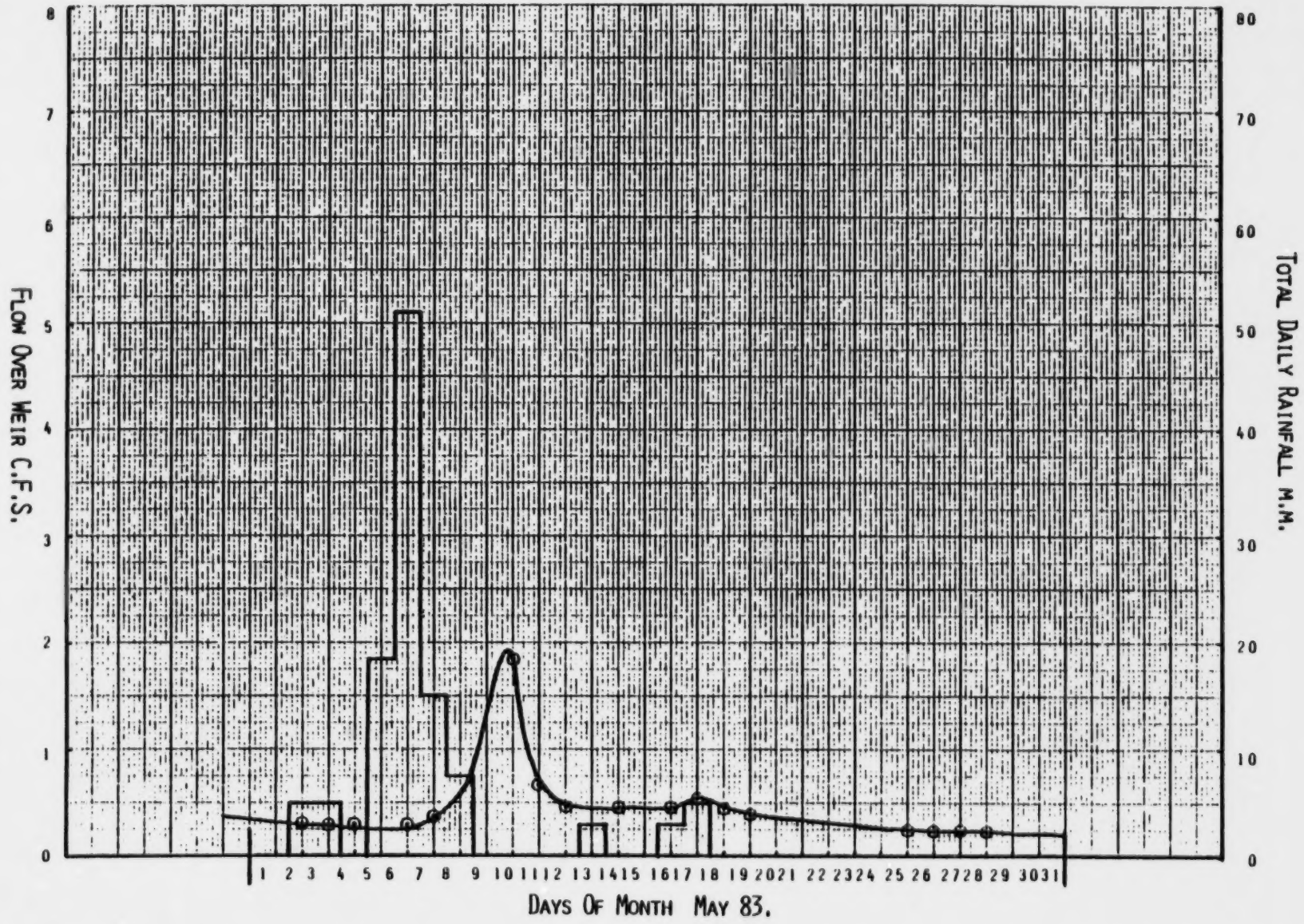
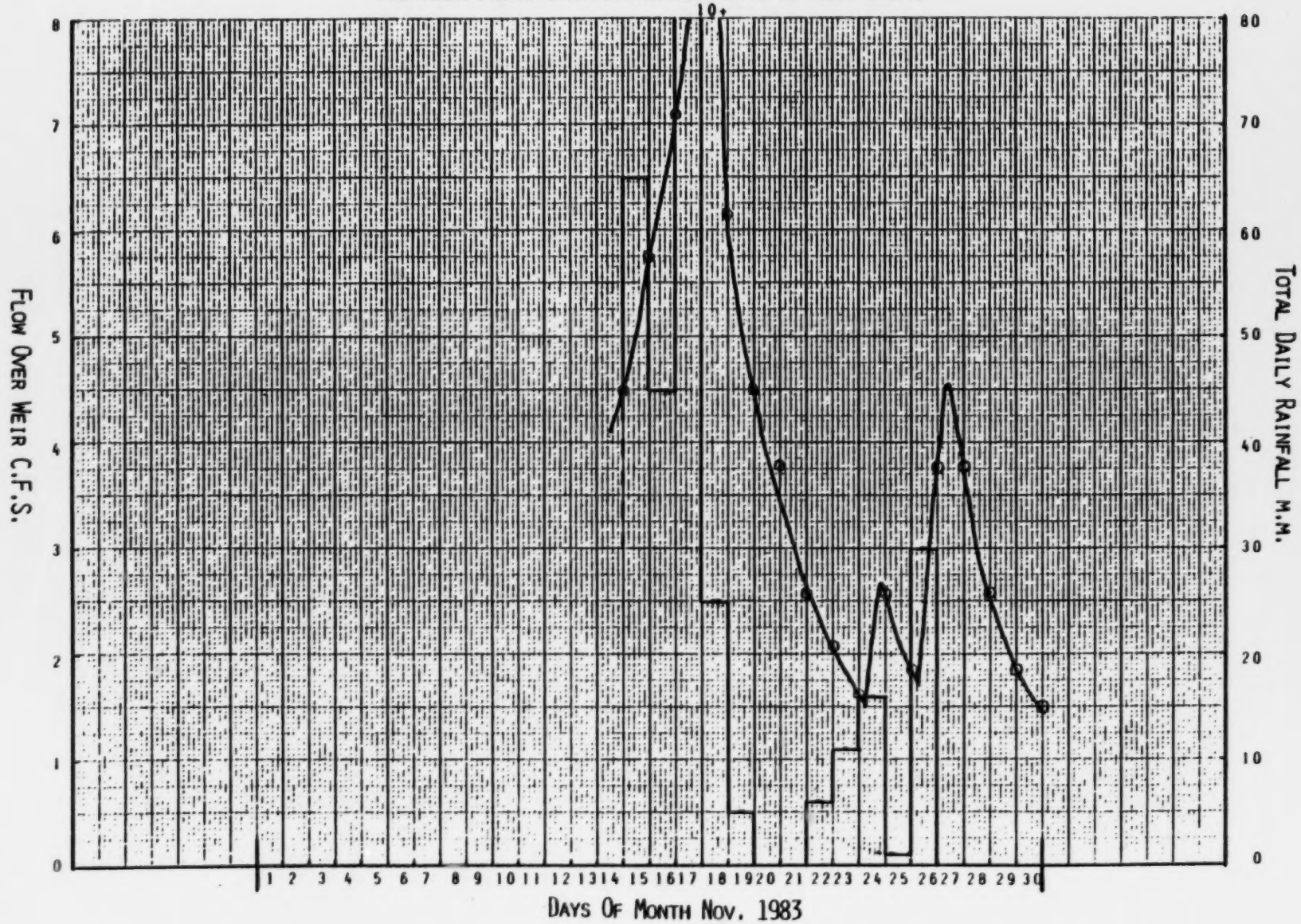
Clearprint Cronaflex

FIGURE 4-5 PLOT OF FLOW DOWN COVER CREEK AT WEIR AND AREA PRECIPITATION AGAINST DAYS OF MAY 1983.



CLEARPRINT PAPER CO. NO. C-25 MILLIMETERS BOTH WAYS 180 X 230 DIVISIONS PRINTED IN U.S.A. ON CLEARPRINT TECHNICAL PAPER NO. 1015
CLEARPRINT CHARTS

FIGURE 4-6 PLOT OF FLOW DOWN COVER CREEK AT WEIR AND AREA PRECIPITATION AGAINST DAYS OF NOV. 1983.



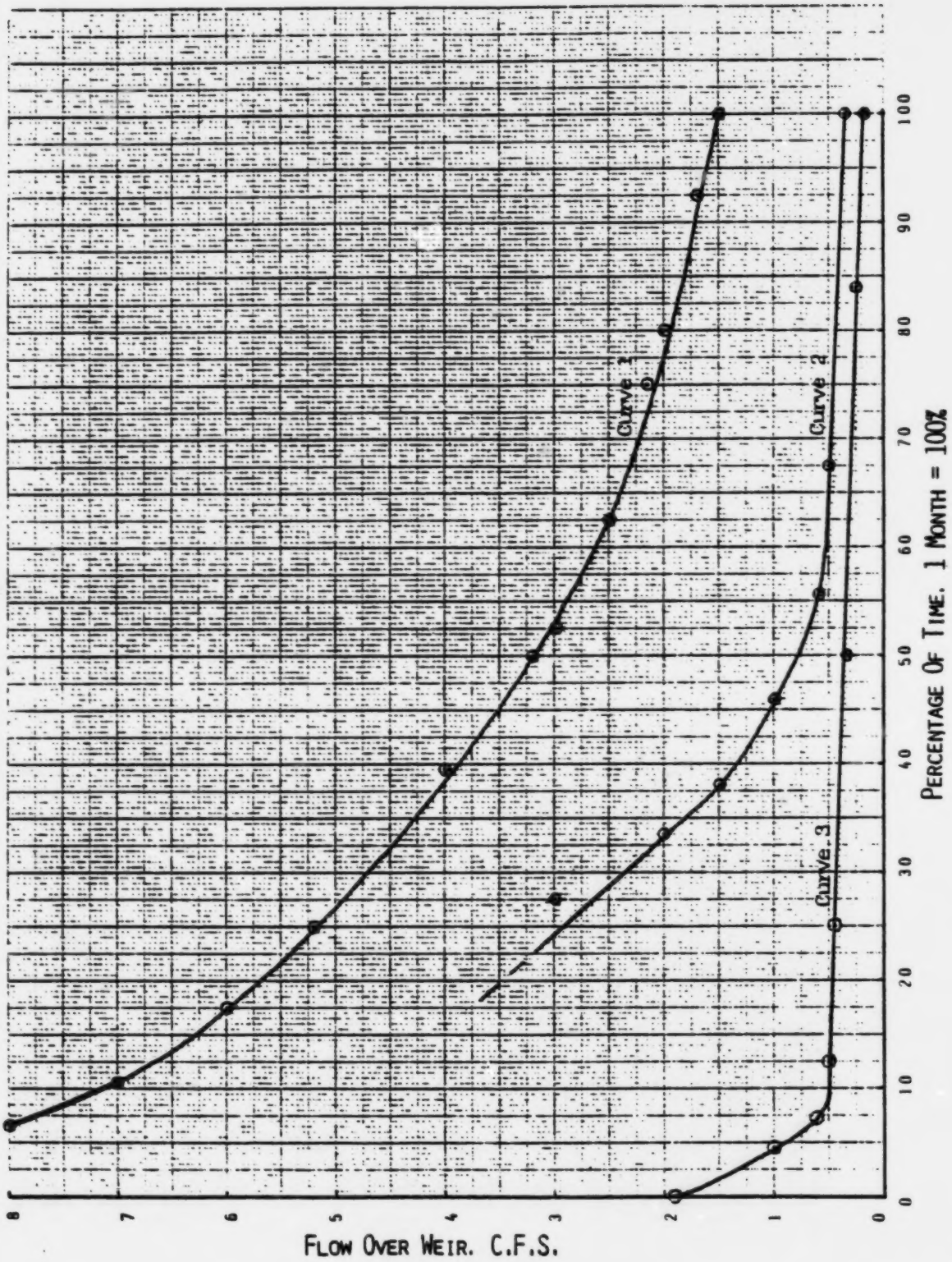


FIGURE 4-7 PLOT OF FLOW DOWN COVER CREEK AT WEIR AGAINST TIME FOR 3 MONTHS OF RECORDS.

FLOW PROBABILITY CURVES DOWN COVER CREEK

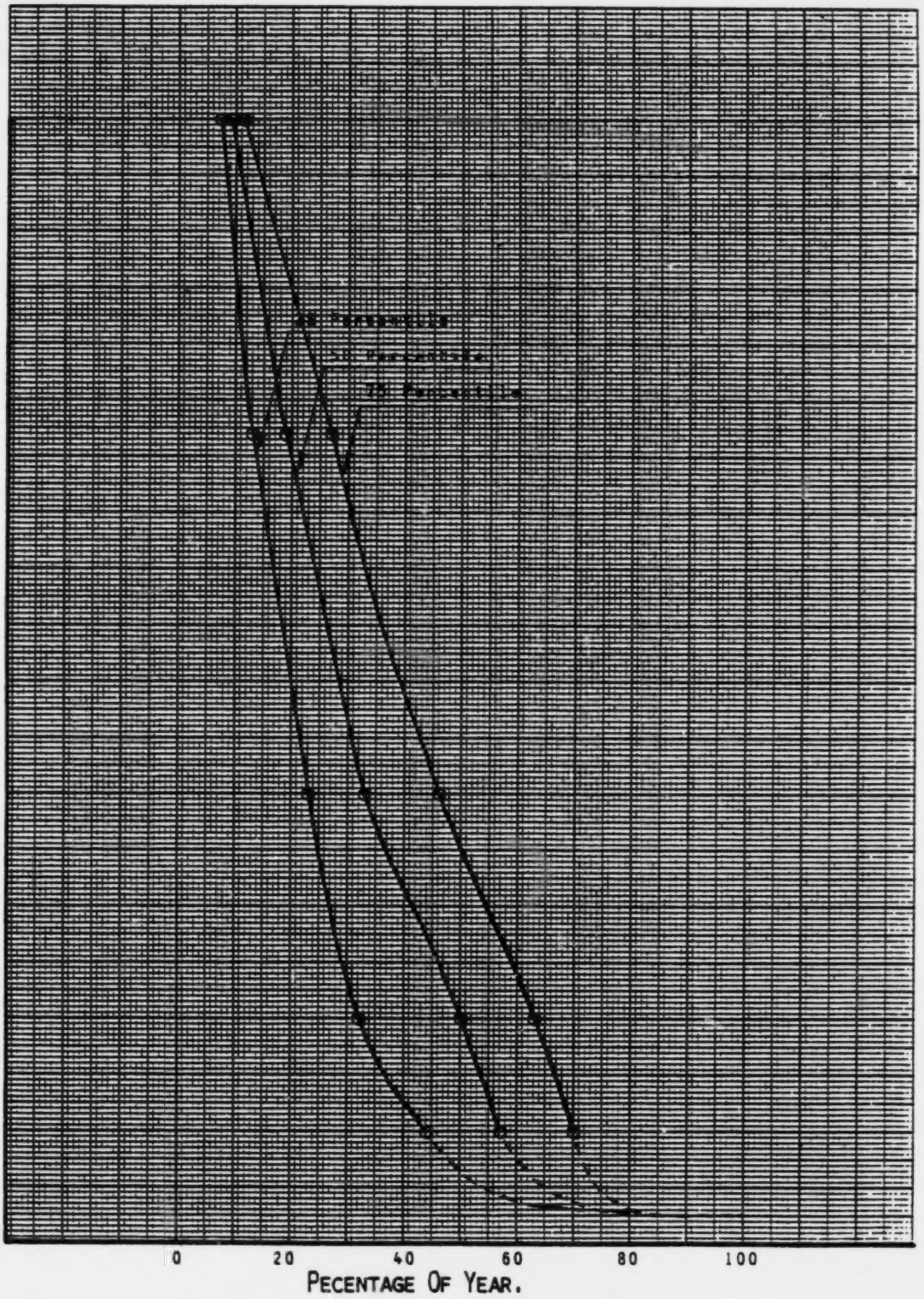


FIGURE 4-8

this watershed was 9.6 times that of Cover Creek the streamflow recession after rainfall was very similar. It was clear that the increased distances that the water must travel down the watershed do not significantly alter the rate of flow recession, i.e. those distances are still very short given the high rate of perculation through the granular soil in such very steep watersheds.

The use of the Cover Creek hydrological model scaled up by the ratio of the area of their watersheds (9.6:1) will result in a representative picture that errs on the conservative side. It is apparent both by reason of the size of the watershed and through reported observations that in the dryest months Lutes will supply more than 9.6 times the Cover Creek dry month flow. However, since the flow data is lacking to estimate this affect, a simple scaled model based on the 9.6 ratio, has been used and the results are reported on Figure 4-9.

FLOW PROBABILITY CURVES DOWN LUTES CREEK

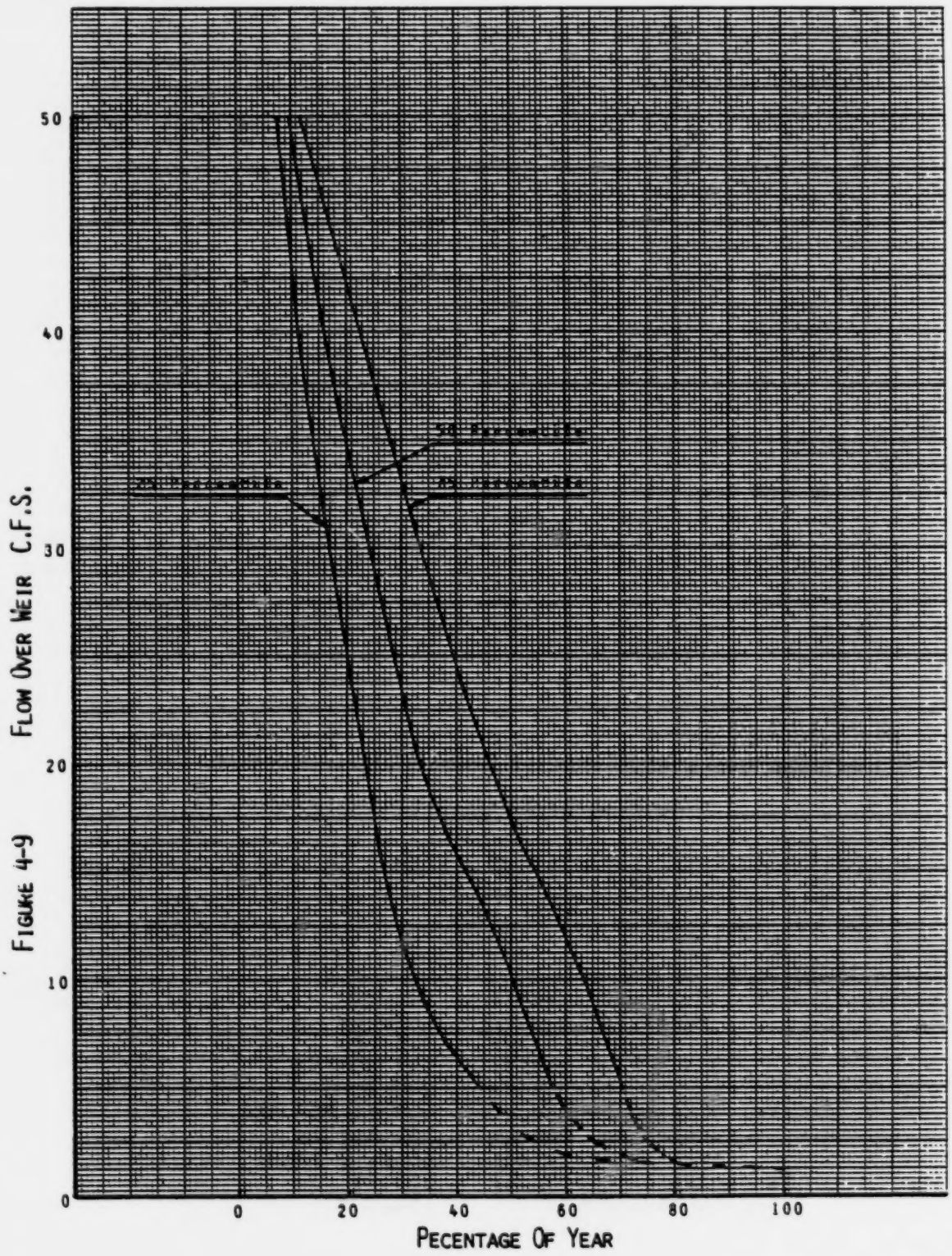


FIGURE 4-9

5.0 COVER CREEK DEVELOPMENT PLAN

5.1 GENERAL APPROACH

The hydrology of this watershed indicated that this stream would be incapable of sustaining the design flow and that there would be frequent periods when the water turbine would be running under reduced flowrates. A higher operating pressure will help compensate and so it was obvious that it should be placed as high as possible.

The site of the proposed intake was eventually specified at a location that would provide a gross head of 311'. At this point the bedrock forced to the surface much of the sub-surface streamflow which was not evident upstream of this location. The stream grade also was significantly less for several hundred feet above this point.

5.2 DESIGN FLOW

A design flow of 4.5 cfs was established. A 10" penstock will deliver enough energy to develop 65 kw of power water to wire (net electrical power delivered). Flows above this value were determined to be too infrequent an occurrence to warrant the larger penstock that would be required. Additionally, the larger the powerplant, the more power is lost in simply spinning the turbine and the generator. This results in lower efficiencies at low outputs - a significant consideration if the periods of reduced output are much longer than the periods of peak output, as in this case. The average flow through the turbine can be computed from the area under the median curve of Figure 4-8. In this case it will be 1.5 cfs.

The probable maximum storm was calculated from the precipitation data for Tahsis which indicated that since 1937 (47 years) the maximum rainfall in a 24 hr period was 7.85 inches. This was projected onto a simple depth-area-duration model for the watershed and was determined to be equivalent to approximately 100 cfs.

5.3 BASIC DATA

Gross Head:	311 FT
Penstock Length:	1490 FT
Design Flow:	4.5 CFS
Penstock Diameter:	10" NOMINAL
Net Head:	280 FT
Velocity in Penstock:	8.2 FT PER SEC.
Theoretical Power:	107 KVA
Power Transmitted:	65 KW 3 PHASE 120/240V
Transmission Distance:	325 FT
Probable Maximum Storm:	100 CFS

5.4 INTAKE WORKS

Figure 5-1 shows the proposed intake site as it presently exists. Figure 5-2 represents the proposed development of that site for the intake works. An access road to the intake site cannot be cost justified given the scale of the project and the difficult terrain. There are a number of dam designs that could be successfully applied to this scale of project. The rock-filled gabion minimizes the use of off-site materials (see p A-14 for a detailed description of gabions, see Figure 6-4 for typical section). The materials that would be required could be easily lifted by helicopter, which routinely provide services in this area to the logging camps.

The spillway should incorporate a downstream concrete apron to prevent erosion. The intake trash screen will likely encounter principally leaves and other small floating debris. Gravel seems to not be very mobile in the streambed because of the numerous large natural obstructions. Similarly, logs or other large debris will not be a problem. Even in high flood there is not enough volume to move large objects.

A simple vacuum breaker consisting of a 2" vertical standpipe coming off the penstock at the intake will protect the penstock should the intake screen become plugged. Shut-off of the intake will be by means of a blind flange which can be rotated for closure. It would be secured with one bolt on the end of the pipe. A level monitoring device will be installed on the inside of the trash rack. A signal from this device will be used to control the flow of water through the turbine.

5.5 PENSTOCK

The west side of the stream was chosen for its more gradual contours, fewer areas of washout at high flood and excellent siting for the powerhouse. The penstock would not be buried. The mild winters do not warrant it and much of the terrain does not permit it.

A plastic line, either of PVC or polyethylene (PE) is recommended for ease of installation and cost. PVC is less expensive but is not as flexible as PE and therefore will have to be supported in the air more often where the ground is irregular. A 10" penstock will require a support every 10 ft for sections above the ground. PE is more expensive to repair if damaged but it is also more difficult to damage

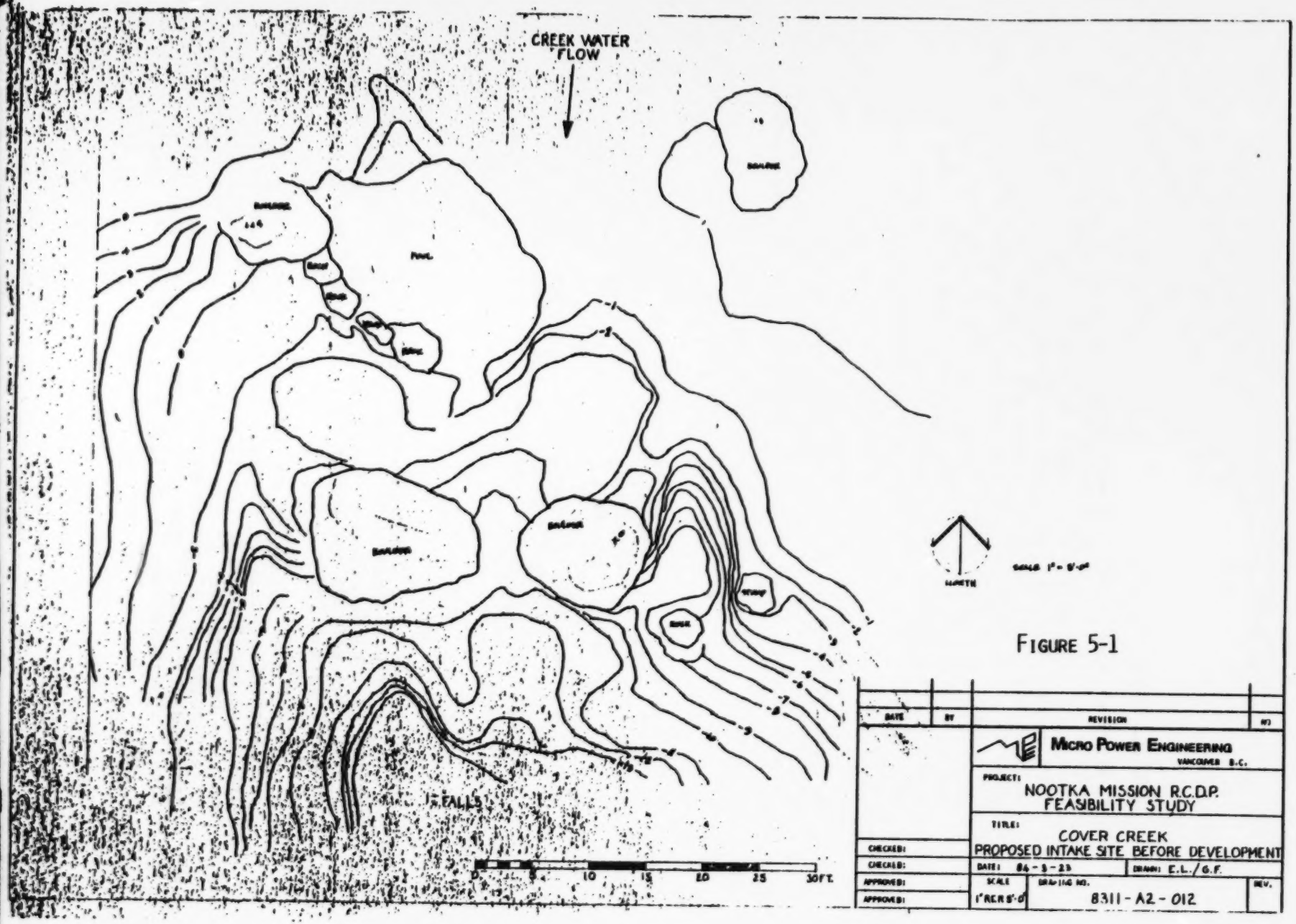


FIGURE 5-1

DATE	BY	REVISION	NO
		MICRO POWER ENGINEERING VANCOUVER B.C.	
		PROJECT: NOOTKA MISSION R.C.D.P. FEASIBILITY STUDY	
		TITLE: COVER CREEK PROPOSED INTAKE SITE BEFORE DEVELOPMENT	
CHECKED:		DATE: 84-8-23	DRAWN: E.L./G.F.
CHECKED:		SCALE: 1"REDUCED	DRAWING NO. 8311-A2-012
APPROVED:			REV.
APPROVED:			

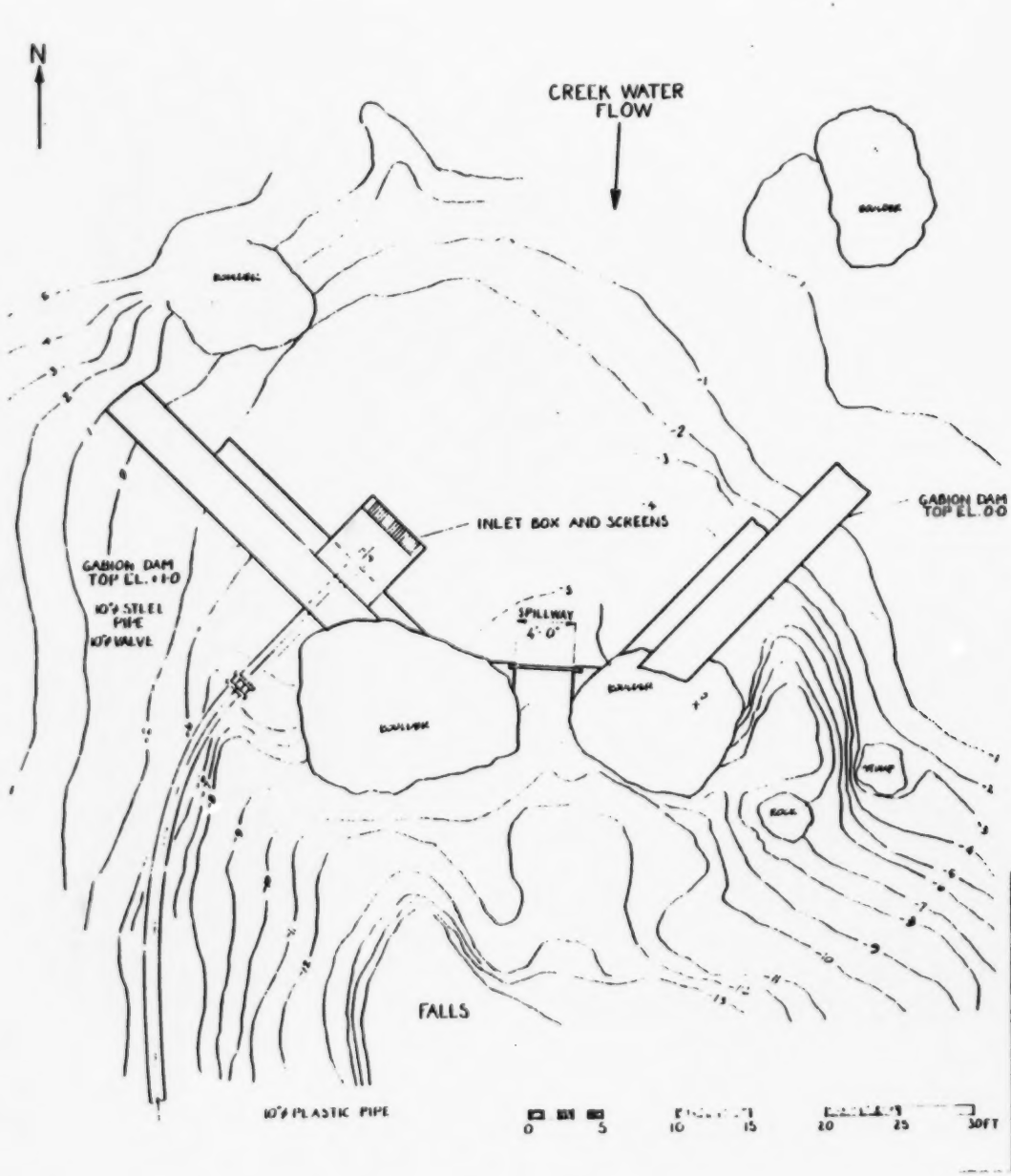


FIGURE 5-2

NOT FOR CONSTRUCTION

Micro Power Engineering

NOOTKA MISSION R.C.D.P.
FEASIBILITY STUDY

COVER CREEK
PROPOSED INTAKE SITE DEVELOPMENT

8311 - A2 - 013

because of its flexibility. The PVC would be manually installed and solvent welded in place. The PE would be heat-fused at the bottom of the hill and dragged up with a winch as a continuous length as each section is connected at the bottom end.

The penstock would have to be anchored at the intake, at the powerhouse and anywhere that there is more than a 7 degree bend in the line. This prevents thrusts from causing movement of the line and subsequent damage.

5.6 TURBINE AND CONTROLS

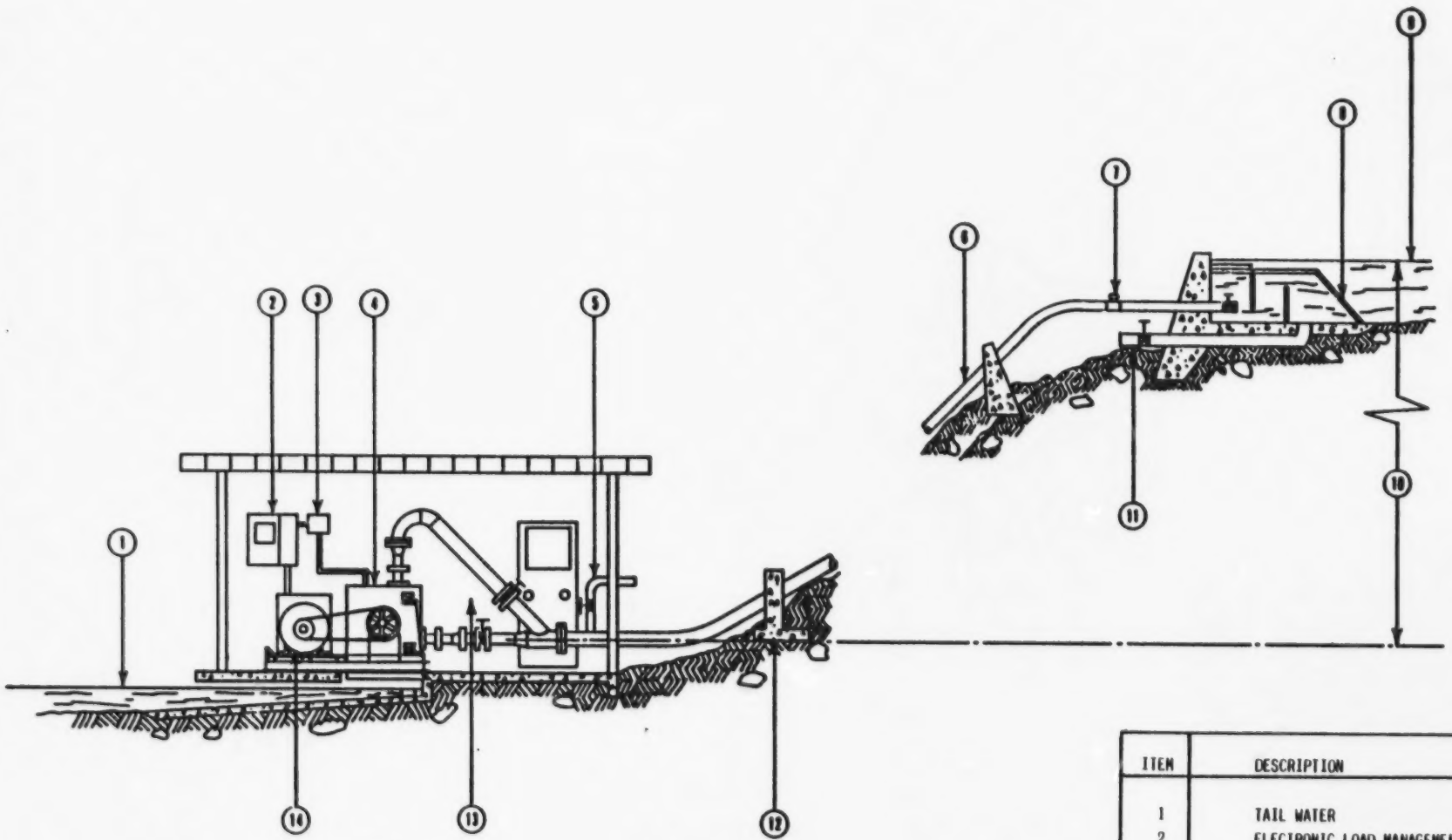
On this scale there are only two likely attractive alternatives for the turbine - a pelton or a turgo impulse turbine. For example, a 9.75 inch pitch diameter pelton capable of two 1 7/8 inch jets or a turgo capable of one 2.5 inch jet would meet the design requirements. A partial list of potential suppliers is given on page A-1 AND A-2 of the appendix.

The technology is well established and there is no significant technical advantage to distinguish these two alternatives. Economics will dictate the choice between these. An analogous site development is depicted in Figure 5-3.

The control options are discussed in detail in section 6.8. The only difference for the Cover creek site is that a 65 kw load dump would be used instead of the 100 kw unit mentioned. It may also be desirable to incorporate an auto-start and synchronizing feature for paralleling the diesel with the small hydro plant - an event that will occur quite routinely with the Cover Creek proposal. The system could be tried manually for a time and upgraded later to auto-start if it proved desirable.

5.7 POWERHOUSE

The powerhouse is to be located on the west side of the stream and 300 ft beyond the existing powerhouse. It is at this point in the stream that the water must be returned to protect the salmon spawning grounds downstream of this point. Figure 5-4. is an example of the type of powerhouse that would be recommended. A good soil foundation exists at the proposed site and will readily accomodate a conventional cement block foundation. Approximately 300 ft of new access road extending from the road to the existing powerhouse would be required. The terrain is flat and sparcely forested.

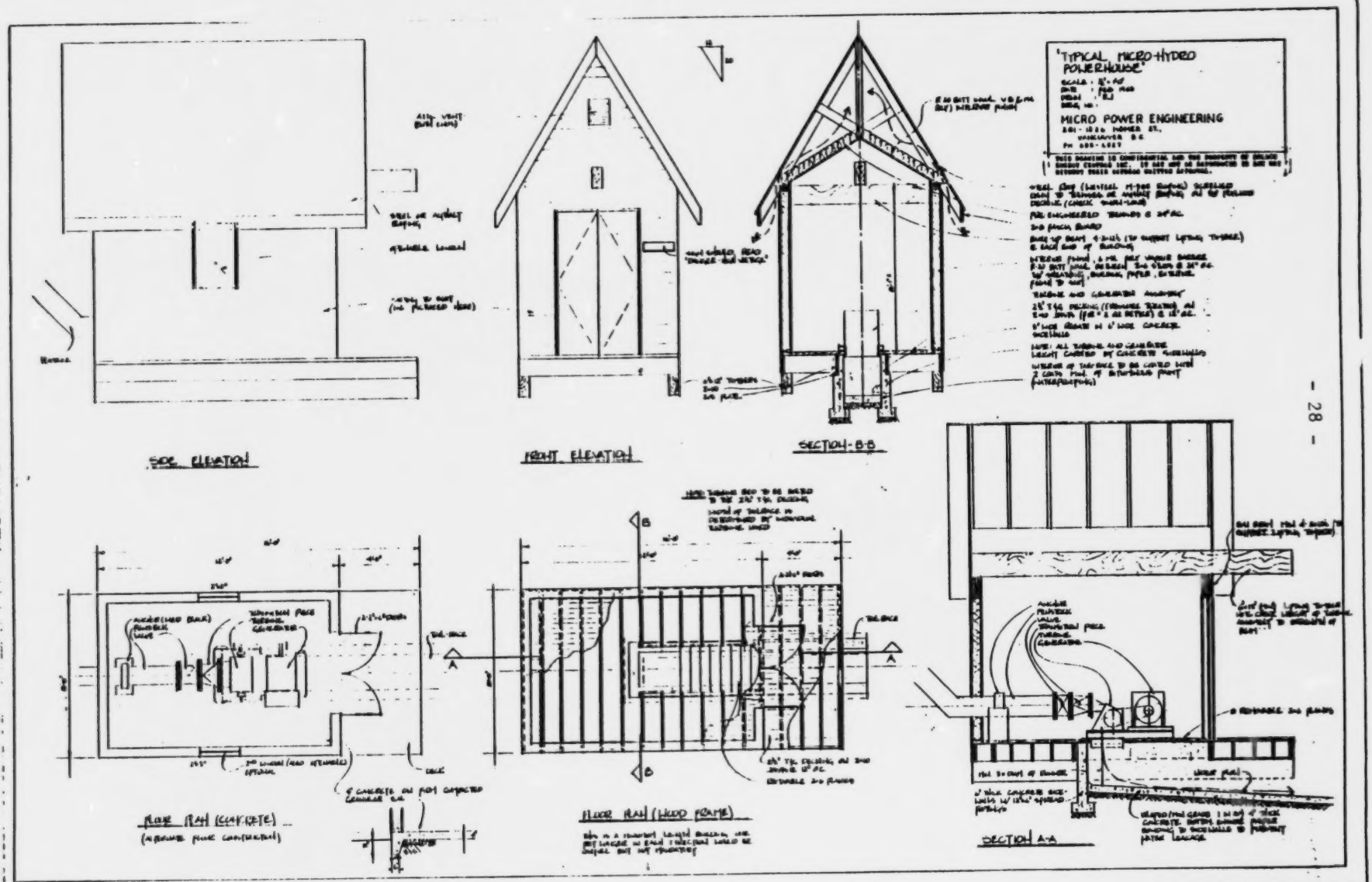


HIGH HEAD SMALL-HYDRO POWER PLANT

FIGURE 5-3

ITEM	DESCRIPTION
1	TAIL WATER
2	ELECTRONIC LOAD MANAGEMENT
3	ELECTRONIC FREQUENCY GUARD
4	TURBINE HOUSING
5	DOMESTIC WATER TAKE-OFF
6	PENSTOCK
7	VACUUM RELIEF
8	TRASH SCREEN
9	HEAD WATER
10	HEAD
11	RESERVOIR DRAIN PIPE
12	PENSTOCK ANCHOR
13	TURBINE PIPE MANIFOLD
14	GENERATOR

FIGURE 5-4 TYPICAL POWERHOUSE DETAIL



5.8 POWER TRANSMISSION

This scheme requires only 300 ft of power transmission cable to tie into the existing power distribution switchgear in the diesel powerhouse. A buried Teck cable is recommended.

5.9 PROJECT COST ESTIMATES -- COVER CREEK

The cost estimates are summarized in Table 5-1. The capital cost for the development of the Cover Creek small hydro proposal is estimated at $77,652.

The cost estimates are based on the design guidelines discussed in the preceding sections. The total cost reflects all taxes, freight, and duties. The project capital costs are reported in March 1984 dollars.

The labour component of these costs reflect the resources and skills known to be available through the community itself. These include personnel who have significant experience with earthmoving equipment, blasting, general construction, logging, carpentry and welding. The community has demonstrated the ability and a willingness to provide much of its own labour for this project. There is also some precedent for funding of this type of temporary employment through a Canada Manpower program such as Canada Works. Costs for outside labour have been assessed for the electrical work, installation and commissioning of the power plant, engineering and project supervision. The estimate for the 'volunteer' component was 15 to 20 man-weeks, assuming skilled people are available.

It is critical to the cost of a project of this scale that most of the detailed engineering be conducted on the site rather than in an office. The engineer should be the project supervisor. The engineering fee quoted assumes that an initial man-week be spent on site to refine the design approach and basic data given here into a bill of materials and construction plan. Subsequently, the engineer should be on site frequently during the construction phase to enable decisions to be made as the work progresses and to ensure the quality of the workmanship.

TABLE 5-1

COVER CREEK COST ESTIMATES

	ITEM DESCRIPTION	AMOUNT
1.0	CIVIL WORKS COMPONENTS	
1.1	ACCESS - 300 FT TO POWERHOUSE	800.
1.2	INTAKE WORKS - WEIR, TRASH RACK	1,712.
1.3	PENSTOCK - PIPE (PVC assumed) THRUST BLOCKS, VALVE AT POWERHOUSE	12,641.
1.4	POWERHOUSE	2,175.
	CIVIL WORKS SUB-TOTAL	$ 17,328.
2.0	ELECTRICAL AND MECHANICAL COMPONENTS	
2.1	300 FT TRANSMISSION, SWITCHGEAR, TIE-INS	2,205.
2.2	LOAD CONTROL, LOAD MANAGEMENT SYSTEMS AND 65 KW LOAD DUMP, LEVEL MONITOR	7,490.
2.3	65 KW SMALL HYDRO POWERPLANT	35,810.
2.5	INSTALLATION ITEMS 2.1 - 2.3	1,500.
	ELECTRICAL AND MECHANICAL SUB-TOTAL	$ 47,005.
3.1	ENGINEERING AND PROJECT SUPERVISION	6,260.
3.2	CONTINGENCIES @ 10%	7,059.
	COVER CREEK TOTAL PROJECT CAPITAL COST	$ 77,652.

Estimated man-weeks of community volunteer labour: 15 to 20 man-weeks

6.0 DEVELOPMENT PLAN - LUTES CREEK

6.1 GENERAL APPROACH

The hydrology of this watershed indicated that flows would closely follow the pattern of Cover Creek except that their magnitude would be increased tenfold. There is apparent no technical impediment to developing several hundred kw from this stream. In short, there are several ways that this stream could be developed for power for Esperanza - unlike Cover Creek which presented a very limited number of alternatives.

The development of Lutes Creek would introduce one significant additional cost component - a 2.0 mile power transmission cable. The lowest cost and best approach from a technical and maintenance perspective is a submarine cable along the shoreline. The advantages are: 1) it eliminates the need for building a very difficult access road along the path of an overhead power line - an expense of several hundred thousand dollars alone, 2) this represents a very direct route to Esperanza, and 3) it eliminates the vulnerability the line would otherwise have to tree falls etc.

A preliminary assessment of the relative cost/benefit scenarios representing the various alternative development plans indicated that 100 kw would be the most attractive scale for several reasons. First, a 5 KV (5,000 volts) cable is required for power transmission and the smallest wire size approved is capable of carrying up to 116 Kw at .8 power factor. Second, this site is going to be more expensive to develop due to the transmission distance and the larger intake works - in this case a larger plant will bring the cost per kw-hr down. Finally, the 100 kw system provides the community with a reasonable level of growth potential allowing for the planned addition of new residences and perhaps some new commercial activities.

The site of the proposed intake was identified as indicated by Figure 6-1 at a point that would provide 200 ft of gross head. This location has good characteristics for the intake works, providing rock abutments and easy access for the penstock. The grade of the creek was significantly less for several hundred feet beyond this point. There is good access from the existing logging road which is in excellent condition after over 20 years of disuse.

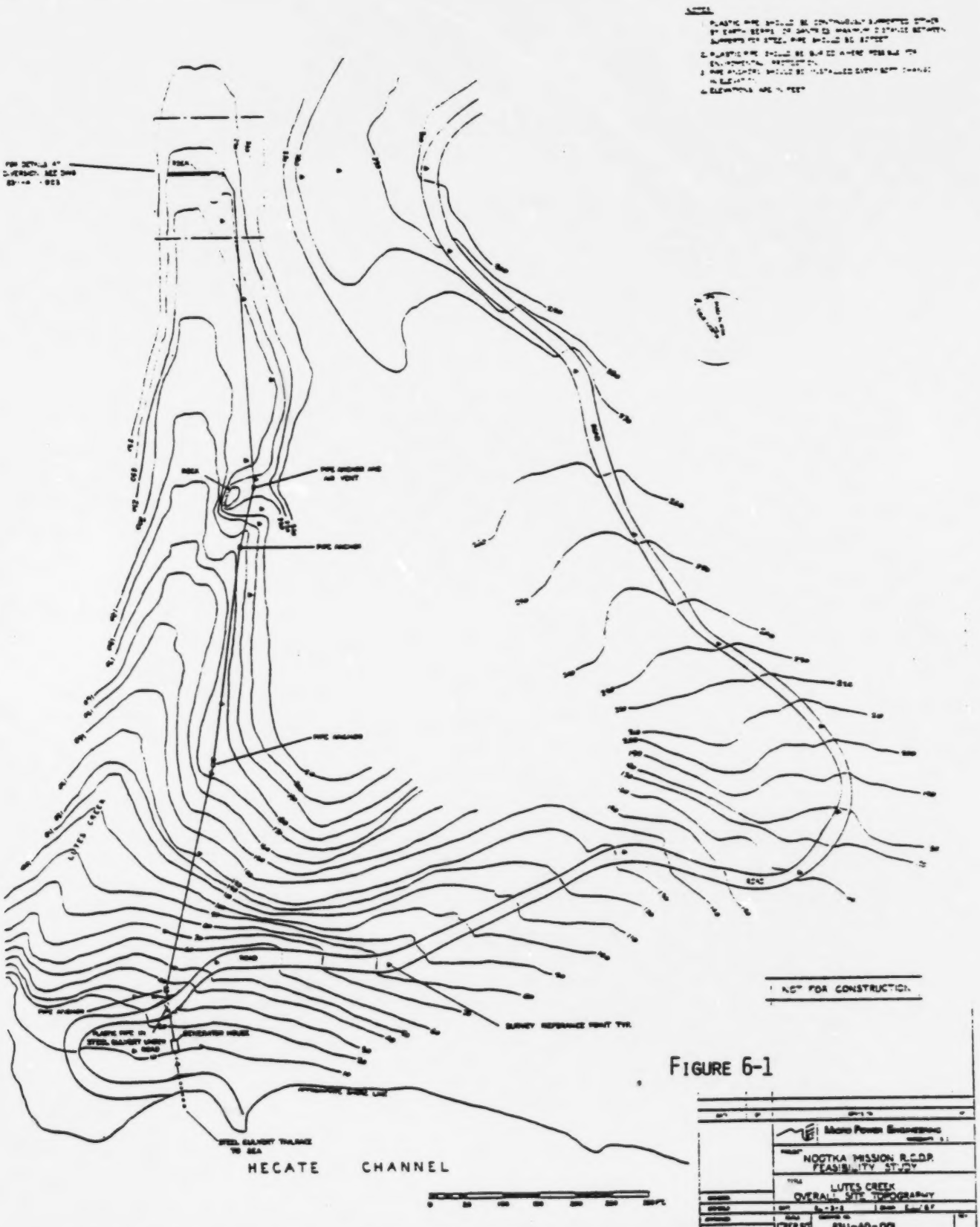

HECATE CHANNEL
NOOTKA MISSION R.C.D.P.
FEASIBILITY STUDY
LUTES CREEK
OVERALL SITE TOPOGRAPHY
831-A0-001

FIGURE 6-1

6.2 DESIGN FLOW

A design flow of 10.9 cfs was selected. A plastic penstock with an ID of about 14.5" will develop 100 kw of power, water to wire, at this flowrate.

6.3 BASIC DATA

Gross Head:	200.	FT
Penstock Length:	1195.	FT
Design Flow:	10.9	CFS
Penstock ID:	14.5	IN.
Net Head:	182.	FT
Penstock water velocity:	9.5	FT PER SEC
Theoretical Power:	168.	KVA
Power Transmitted:	100.	kw 3 phase 5 KV
Transmission Distance:	2.0	miles
Probable Maximum Storm:	960.	CFS

6.4 INTAKE WORKS

Figure 6-2 shows the character of the existing site of the proposed intake. An access road to the intake works would require an extension from the logging road of 500 ft - 300 ft is over flat terrain and the last 200 ft would cut across a steep grade which has good soil cover. There is an existing makeshift old wooden dam immediately downstream of the proposed weir. This should be blasted out in late summer to allow the high winter flows to wash down the gravel retained behind it.

A rock-filled gabion weir with an impermeable membrane and concrete caps is recommended. The plan, profile and section of the weir are shown in Figures 6-3 and 6-4, respectively. The impermeable membrane is placed so that silt and other fines can gradually fill the voids in the gabions and will eventually render the gabions themselves impermeable. Several large boulders will have to be blasted before construction and these can provide material for the gabions. Small boulders will be placed on the downstream side of the weir to help dissipate the force of the water spilling over it.

A 24 inch culvert is provided to flush out accumulated gravel by opening this once a year during a period of high flow. There is a possibility of logs or other large debris being washed down the stream. The intake is protected from these and from the accumulation of gravel by an upstream curtain wall. This also prevents the accumulation of trash in the backwater side eddies that would otherwise exist. A

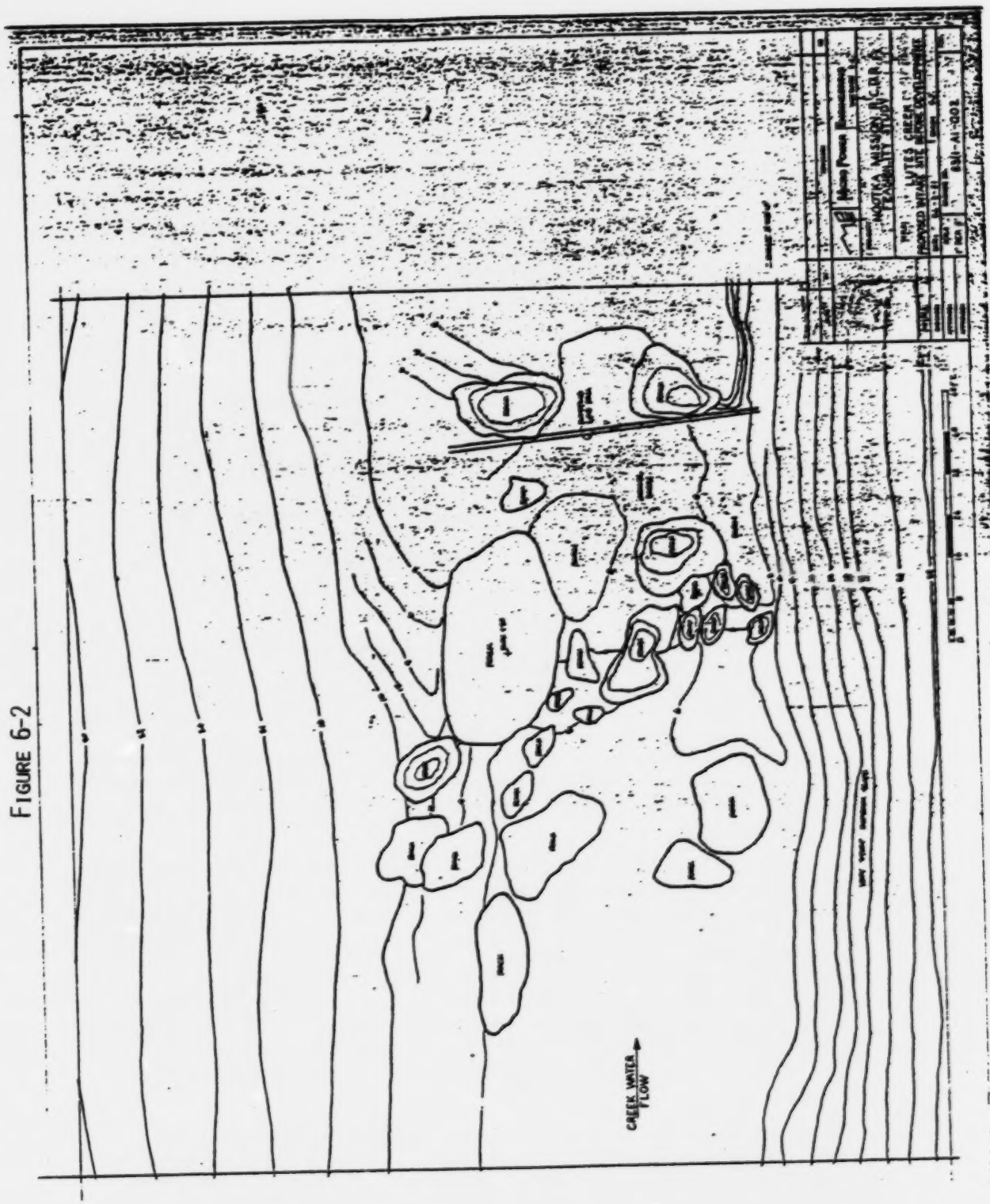


FIGURE 6-2

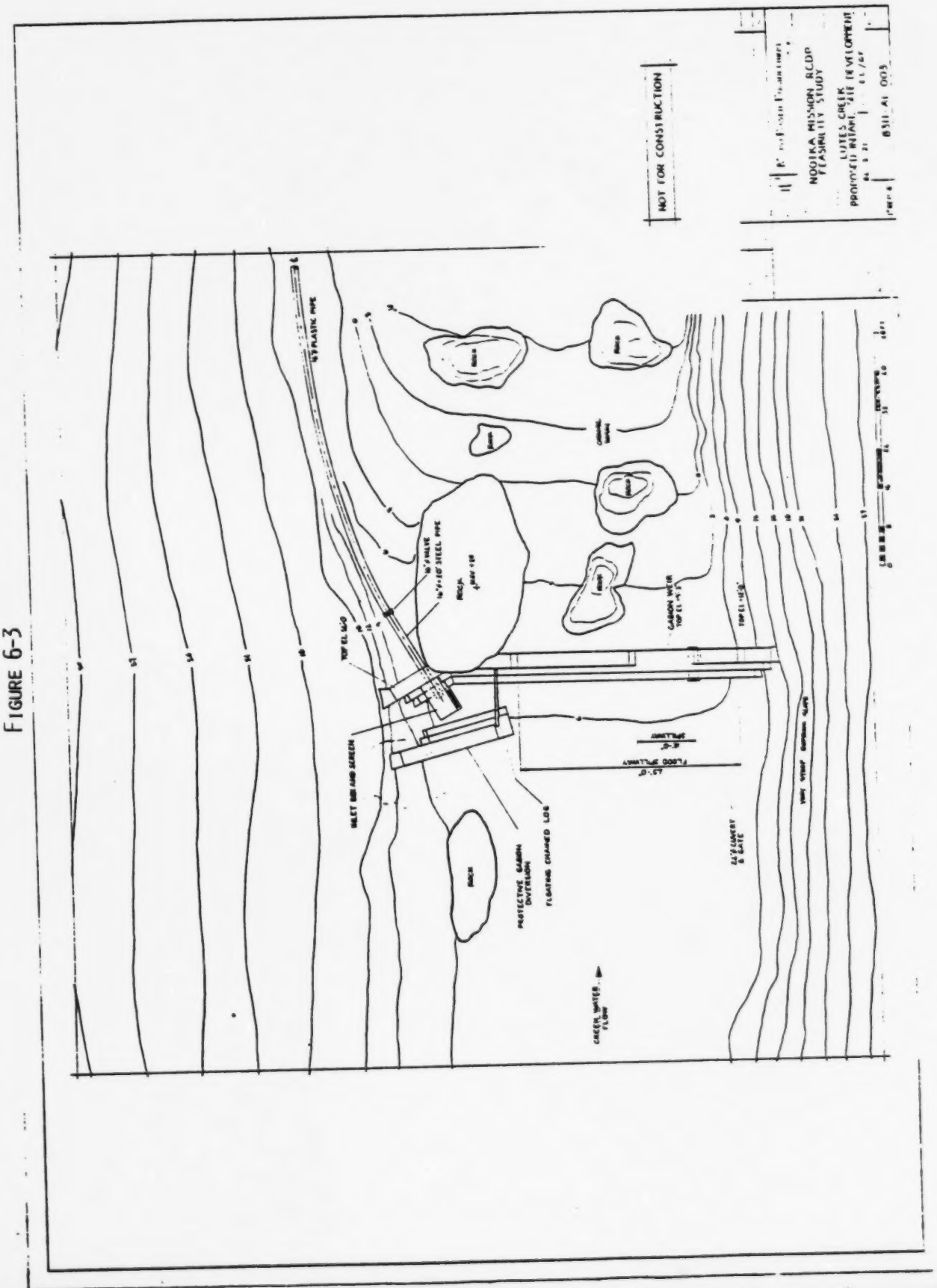
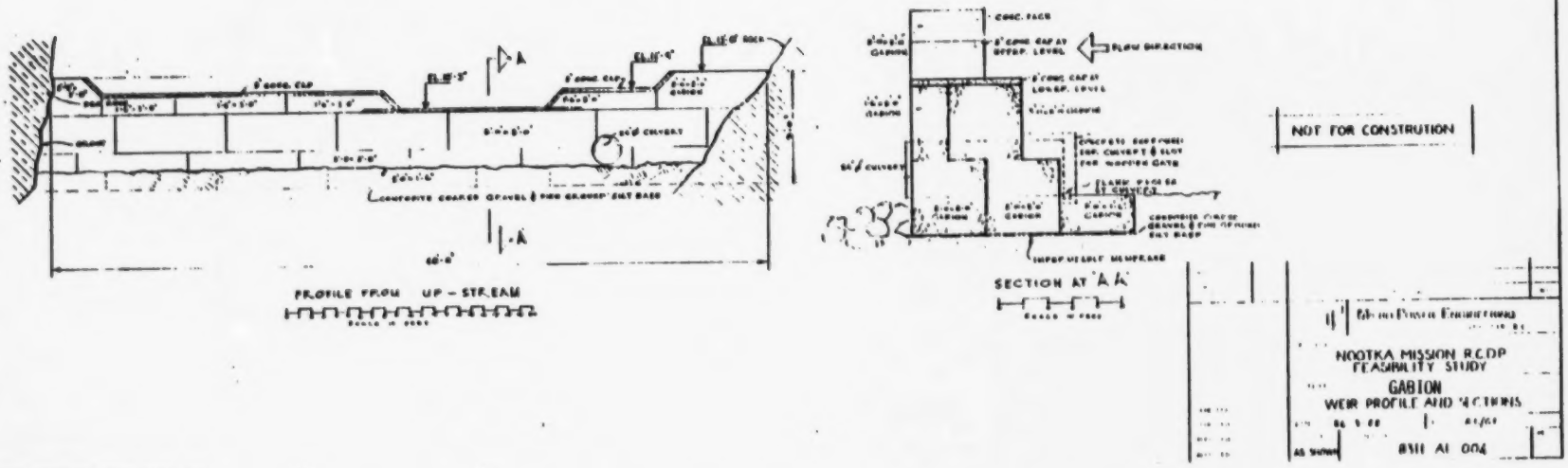

NOT FOR CONSTRUCTION
NOOTKA MISSION RCDP
FEASIBILITY STUDY
LUTES CREEK
PROPOSED INTAKE SITE DEVELOPMENT
BSH-AI-005
6" PLASTIC PIPE
6" VALVE
10"ø STEEL PIPE
ROCK
TOP EL 160
TOP EL 145
GABION WATER
TOP EL 145
TOP EL 150
SILT BIB AND SCREEN
PROTECTIVE GABION
DIVERSION
FLOATING CHANGED LOG
ROCK
CREEK WATER
FLOW
12"ø LOWER
6 GATE
VAN STONE BARRIER SLAB

FIGURE 6-3

FIGURE 6-4


NOT FOR CONSTRUTION
PROFILE FROM UP - STREAM
SECTION AT 'A-A'
NOOTKA MISSION R.C.D.P.
FEASIBILITY STUDY
GABION
WEIR PROFILE AND SECTIONS

low flow and a high flow spillway is provided.

It is possible that under maximum flood conditions (determined by the method outlined in section 5.2) the entire width of the main body of the weir will be overflowed. This is acceptable because both ends of the weir are secured onto the rock faces existing. The section of the weir over the intake will be 2 ft higher than the main body of the weir to prevent overflow at this point.

A vacuum breaker, blind flange for shut-off and a level monitor as described in section 5.4 will be required.

6.5 PENSTOCK

The routing for the 14.5 " penstock on the east side of Lutes Creek is shown in Figure 6-1. The west side of the stream is not accessible due to very steep bedrock slopes continuing all the way along the creek.

The terrain along the path of the penstock can be considered in two sections. The first 1000 foot section cuts across the contours at a very gentle grade. The contours themselves vary from gentle slopes to quite steep slopes and all with good soil coverage. The second section - the last 490 ft - runs down perpendicular to the contours (the steepest line of descent) at a very steep grade.

The penstock would not be buried. It would run directly on the ground as much as possible. The forest is mature along the penstock route and there is little danger of treefall. A plastic line is recommended for the reasons discussed in Section 5.5.

The first 1000 ft would require very few pipe supports or thrust blocks. Generally thrustblocks are recommended wherever the pipe bends more than 7 degrees. A small excavator could be used to clear a trail for the penstock. Access is easy and there is plenty of soil cover. It would be important to ditch the trail properly to prevent erosion due to the relatively steep drainage being crossed.

A major thrustblock would be required at the top of the final 490 foot steep section and also at the bottom of the hill where the penstock levels out to cross the logging road. The use of an excavator is prohibited along this section due to the steepness of the grade. Low supports, perhaps every 10 ft, would be required along this section because of the slightly stepped nature of the slope.

The first 20 ft of pipe at the top of the penstock and the last 20 ft at the bottom should be steel to protect the line against damage at these critical locations.

The penstock must cross a rock knoll approximately 500 ft downstream of the intake site. To go up and over the knoll would still require a 4 to 6 ft deep trench at the top to ensure that the pipe would still be below the elevation of the intake works - otherwise the pipe will not fill with water beyond this point. An air vent would also be required to ensure that any air trapped at the rise would be allowed to escape. Alternatively, material would have to be excavated or blasted to a depth of about 16 ft to eliminate the rise. It is not possible to go around the knoll.

The penstock would pass through a culvert which would be buried under the logging road just before the powerhouse. This will protect the line should the road ever again be used for heavy equipment.

6.6 TURBINE

On this scale the most likely alternatives for the turbine are the pelton or turgo impulse turbines. A 15" pelton would have to be capable of up to two 3" diameter jets. A 12.5" diameter crossflow turbine would typically require a 6" runner width. A partial list of suppliers for this equipment is included on pages A-1 and A-2 of the appendix. The technology is well established and there is no significant technical advantage between these alternatives. Economics will dictate the ultimate choice. A typical installation is depicted in Figure 5-1.

6.7 CONTROLS

The recommended control elements would consist of the following:

a. Load Control. This system controls the line frequency by shedding any excess power into a 100 kw power dump which typically consists of an immersion heater in a tank (standard heaters of this type are available from Chromalox). The power to this source is intermittent depending on the fluctuations in power demand elsewhere on the system. If it seems that a considerable amount of energy will end up in this location - as would be expected at least in the short term at Esperanza for the Lutes development - then the energy may be applied to space heating by using a water to air heat exchanger to tie into a forced air heating system. Buildings C-1 or C-2 are likely candidates for this application.

b. Auto-Flow Control. The available flow in the stream is interpreted by a level monitor installed at the intake works. A low voltage signal transmitted by means of a bell wire cable following the penstock would be interpreted at the powerhouse by a flow controller. This in turn will actuate a flow regulating device on the turbine so that it does not try to draw more flow than the stream is capable of providing. It is important to place the monitor inside the trash rack so that if the rack becomes plugged the turbine will be safely shut down.

c. Load Management. Control modules are available which allow the establishment of a broad range of load priorities. The purpose of load management is to try and keep as much as possible of the total power being produced, doing the most useful work. As a simplified example consider this:

> A 6 kw clothes dryer shuts off automatically at the end of a normal cycle and therefore creates a 6 kw surplus of power. The load management system detects this instantly and signals a relay which turns on a 6 kw hot water tank. The water tank stays on until its thermostat detects that it has reached the desired temperature and then the hot water tank shuts off. The load management system detects this and signals another relay to turn on the next lowest priority, which might be two 3 kw electric space heaters in a basement. This continues until all the load alternatives programmed into the load management module are exhausted, at which time the 6 kw will be sent to the 100 kw load dump described in a) above.

Technically, each building could have its own load management module with up to 8 levels of priority (or alternative loads sequenced by priority), but practically this is not warranted.

d. Fail-Safe Shut-Down. This function is incorporated onto the turbine so that if any potentially destructive condition arises, the powerplant is safely shut-down. Events that could trigger this include a plugged trash rack or a broken or short-circuited power transmission cable.

e. Parallel Operation. In the driest months the turbine output may have to be supplemented with a 25 kw diesel unit. This is easily done manually with a synchronizing relay which does not permit the connection of the diesel power to the distibution system until its frequency is matched to that of the small hydro system. This could also be done totally automatically but in the case of the Lutes

development it should not be necessary. The diesel would be located in the existing powerhouse at Esperanza.

6.8 POWERHOUSE

The proposed location of the powerhouse is indicated on Figure 6-1. This point is about 8 ft above the highest tide level. A 30" culvert would connect the tailrace of the turbine with the small bay directly down from the powerhouse. The soil conditions at the site will permit the construction of a conventional block foundation.

6.9 POWER TRANSMISSION

Submarine cable is by far the least expensive and most expedient mode of power transmission. The cable would follow the shoreline 2.0 miles directly to Esperanza.

The specification for the cable is as follows:

> Consisting of one cable with 3 solid soft bare copper conductors of 8 awg. Each conductor shielded with .020 X-LINK PE and insulated with .090 X-LINK PE cabled with DUPAK fillers corr. poly binding all 3 conductors into a single .080 PVC jacket wrapped with galvanized steel armour consisting of 22 X #10 bwg SWA and Hessian tape. Total comprising a single 5 kv unshielded submarine cable.

Power would be generated at 600 volts three phase and transformed to 4160 volts three phase and transmitted delta to delta to another transformer near the shoreline at Esperanza. There it would be stepped down to 120/208 three phase and cabled to tie into the existing distribution system in building I-1. Oil-filled, weatherproof, pole mounted transformers have been assumed.

Depth soundings were taken along the shoreline at locations where the hydrographic map (Esperanza Inlet, map # 3663) of Figure 6-5 indicated that drop-offs of 100 to 200 ft passed close to the shoreline. At all but one of these locations depths were found of less than 60 ft at points 60 ft from shore. At one location marked as 'X' on Figure 6-5, the depth was over 100 ft.

A diver would be required to ensure that the cable was safely laid on the bottom. The point of over 100 ft depth may require rock anchors to hold the cable along the face of the underwater cliff, if indeed there is no shallower shelf closer to the shoreline. The submarine cable must be buried into the beach where it is intertidal, going into and coming

FIGURE 6-5

HYDROGRAPHIC MAP FOR LUTES CREEK SUBMARINE CABLE

DEPTHS IN FATHOMS
(under 11 in fathoms and feet)

reduced to Lowest Normal Tides

Sloped soundings are enlarged from smaller scale surveys

Underlined figures on drying banks or in brackets against drying rocks express heights in feet above the datum of soundings. Other heights are expressed in feet above Higher High Water, Large Tides.

For complete list of Symbols and Abbreviations see Chart No. 1

Scale 1:40,000 (Lat. 49° 52')

Projection : Mercator

TIDAL INFORMATION

LOCATION	Height above Datum of Soundings									
	Large Tides				Average Tides				Mean Water Level	
	Higher H.W.		Lower L.W.		Higher H.W.		Lower L.W.			
	feet	metres	feet	metres	feet	metres	feet	metres	feet	metres
Tahsis	14·4	4·4	0·7	0·2	12·4	3·8	3·3	1·0	8·1	2·5
Ceepeecee	13·6	4·1	−0·3	−0·1	11·6	3·6	2·3	0·7	7·2	2·2

BENCH MARKS

The datum of this chart at Tahsis is 68·44 feet (20·86 metres) below a bronze tablet, H.S. 8342, 1961, set in the cement step at the front entrance to the United Church.

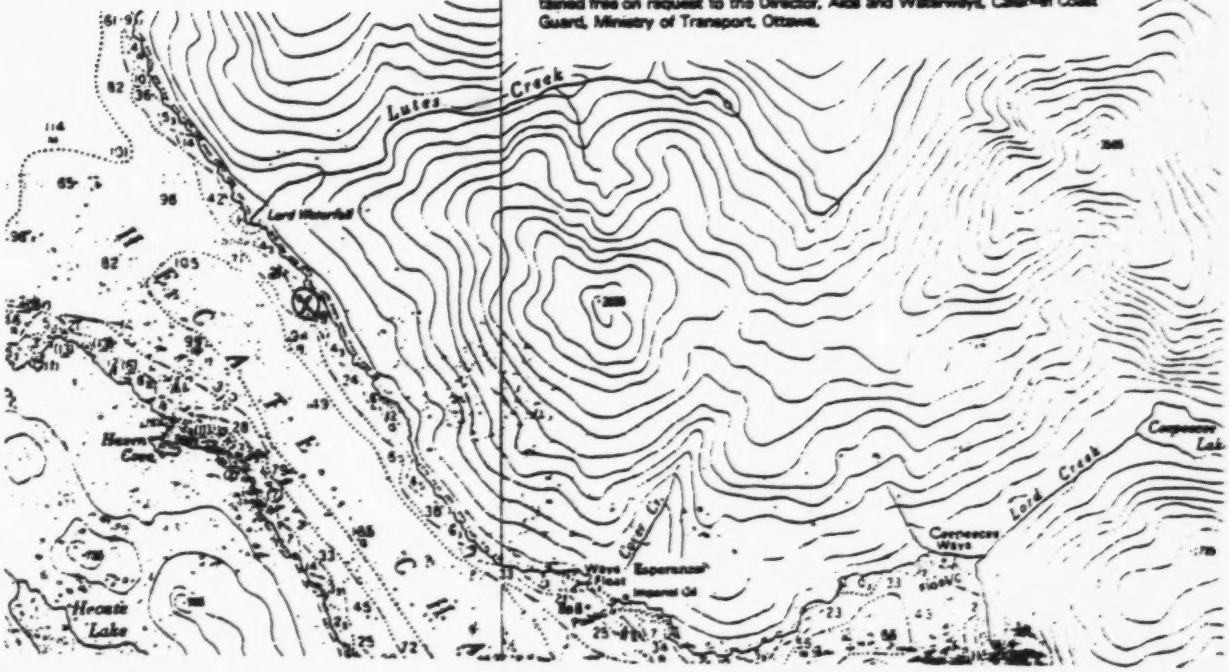
The datum of this chart at Ceepeecee is 8·10 feet (1·56 metres) below a brass plug set in rocky foreshore near the northern corner property stake of Canadian Packing Company.

The datum of this chart at Queen Cove is 12·87 feet (3·92 metres) below a brass plug H.S. 1925, set flush in rock on the northern end of the island at the entrance to Queen Cove.

FATHOMS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	
FEET	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	
METRES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Information concerning Canadian Nautical Charts, Sailing Directions, Tide Tables and other Government publications of interest to mariners may be obtained on request to the Dominion Hydrographer, Canadian Hydrographic Service, Department of Fisheries and Oceans, Ottawa.

Canadian "Notices to Mariners" published weekly, contain important navigational information including amendments to Canadian Charts, Sailing Directions, Lists of Lights and Lists of Radio Aids. These "Notices" may be obtained free on request to the Director, Aids and Waterways, Canadian Coast Guard, Ministry of Transport, Ottawa.



out of the water. The installation of this cable is regulated by Transport Canada under the Navigable Waters Protection Act as well as by the Provincial Electrical Inspection Branch. This is discussed in detail in section 8.0.

6.10 PROJECT COST ESTIMATES -- LUTES

The cost estimates are summarized in Table 6-1. The capital cost for the proposed Lutes Creek small hydro development is $198,035.

These estimates are based on the design guidelines discussed in the preceding sections. The total cost reflects all taxes, freight, and duties. The project capital costs are reported in March 1984 dollars.

The labour component of these costs reflect the resources and skills known to be available through the community itself. These include personnel who have significant experience with earthmoving equipment, blasting, general construction, logging, carpentry and welding. The community has demonstrated the ability and a willingness to provide much of its own labour for this project. There is also some precedent for funding of this type of temporary employment through a Canada Manpower program such as Canada Works. Costs for outside labour have been assessed for the electrical work, installation and commissioning of the power plant, engineering and project supervision. The estimate for the 'volunteer' component was 25 to 30 man-weeks, assuming skilled people are available.

It is critical to the cost of a project of this scale that most of the detailed engineering be conducted on the site rather than in an office. The engineer should be the project supervisor. The engineering fee quoted assumes that an initial man-week be spent on site to refine the design approach and basic data given here into a bill of materials and construction plan. Subsequently, the engineer should be on site frequently during the construction phase to enable decisions to be made as the work progresses and to ensure the quality of the workmanship.

TABLE 6-1

LUTES CREEK COST ESTIMATES

	ITEM DESCRIPTION	AMOUNT
1.0	CIVIL WORKS COMPONENTS	
1.1	ACCESS - 550 FT TO INTAKE, 900 FT ALONG PENSTOCK	4,000.
1.2	INTAKE WORKS - WEIR, TRASH RACK	4,317.
1.3	PENSTOCK - PIPE (polyethylene assumed) THRUST BLOCKS, VALVE AT POWERHOUSE	23,322.
1.4	POWERHOUSE	3,175.
	CIVIL WORKS SUB-TOTAL	$ 34,814.
2.0	ELECTRICAL AND MECHANICAL COMPONENTS	
2.1	SUBMARINE CABLE - 3.3 Km	33,190.
2.2	TRANSFORMERS, SWITCHGEAR, TIE-INS	8,997.
2.3	LOAD CONTROL, LOAD MANAGEMENT SYSTEMS AND 100 KW LOAD DUMP, LEVEL MONITOR	11,305.
2.4	100 KW SMALL HYDRO POWERPLANT	69,190.
2.5	INSTALLATION ITEMS 2.0 - 2.4	11,000.
	ELECTRICAL AND MECHANICAL SUB-TOTAL	$133,682.
3.1	ENGINEERING AND PROJECT SUPERVISION	11,536.
3.2	CONTINGENCIES @ 10%	18,003.
	LUTES CREEK TOTAL PROJECT CAPITAL COST	$ 198,035.

Estimated man-weeks of community volunteer labour: 25 to 30

7.0 FINANCIAL ANALYSIS

7.1 METHODOLOGY

The fact that the community of Esperanza exists legally not as a corporate entity but as a non-profit society reflects significantly on the method chosen for financial evaluation. First of all it means that there are no tax considerations against the savings or the depreciation. Neither is the accelerated capital cost allowance available which normally provides for a three year write-off of the fixed capital investment (since there are no taxes to write anything off against).

Typical of perhaps most remote communities, there is also limited access to conventional sources of financing. This is due to the historical absence of significant commercial activities that would be directly owned and operated by the community rather than its individuals. Also, there is generally a lack of fixed capital assets or adequate real estate values to support a mortgage. The implication is that the financial institutions will be an unlikely source for long term financing. In the absence of some form of government assistance the community itself will have to raise a significant amount of the capital and finance any shortfall against whatever assets are available with probably not more than a 10 or 15 year term.

The present value method (all dollars are March 1984 dollars) is used to assess the cash position over the life of the development from the perspective of three scenarios for the financing.

The first, referred to here as 'Conventional Financing' assumes that all the required funds are borrowed at 14% per annum with a ten year term. A 5% inflation rate is assumed to return the normally equal yearly payments back to 1984 dollars.

The second, referred to here as 'Interest Free' (actually the interest is equal to the rate of inflation), assumes the funds are loaned and will be payed back in inflated dollars out of the projected savings against the 'diesel only' alternatives. This is analogous to the Nootka Mission Assn. raising the money through a charitable foundation. It also gives an indication of what the simple payback on the investment would be if the community had raised its own funds for the project.

The third, referred to as 'Donation', assumes that the money

is simply raised and not expensed at all against the project. This is analogous the Mission raising the funds from its supporting base of individuals or churches.

Finally, two different perspectives are identified for determining the comparable costs of the 'diesel only' alternatives.

One extreme, referred to as 'Existing Diesel', would submit that the community could get by forever with the existing 62 KVA diesel operating 12 hrs a day. The nature of a run-of-the-river small hydro system is such that it operates 24 hours a day at its maximum output depending on the available streamflow. This means that there is always a good deal of off-peak power available. Any small hydro plant that provides the same peak power capacity as a diesel will normally generate many more total kw-hrs per year. The extreme conservative view would then maintain that every extra kw-hr is really of no value at all. There is no allowance made for load growth. This assessment will also give an indication to the community of what their costs will be if they do nothing about their existing methods of producing and using electricity.

The other extreme, referred to as 'Diesel Equivalent', for assessing the comparable 'diesel only' costs, assumes that every kw-hr of small hydro power produced displaces a kw-hr of diesel generated electricity. This is closer to the likely situation than the previous view. There will certainly be times, however, that power will be going to loads of such low importance that they would not otherwise be used, or would be heated with some other cheaper fuel if the power was being 'diesel only' generated.

The true picture obviously lies somewhere between these two extreme views and likely closer to the Diesel Equivalent. It is largely determined by the perceived future growth and activities of the community.

7.1 SUMMARY OF FINANCIAL ANALYSIS

The basic data for the calculations is summarized in Tables 7-1 and 7-2. These outline the operating scenarios and the assumptions with respect to operating and maintenance costs (O & M) and fuel consumption.

The results of the financial analysis as outlined above are summarized graphically in Figures 7-1 and 7-2 and reported in Table 7-3. The year to year detailed calculations are provided in Tables A-7 to A-11 in the appendix.

TABLE 7-1

OPERATING AND MAINTENANCE (O&M) AND FUEL CONSUMPTION BASIS

POWERPLANT	ANNUAL O&M	MINOR OVERHAUL	MAJOR OVERHAUL	REPLACEMENT COST
156 KVA DIESEL	$ 3,000.	$ 2,000.	$ 8,000.	$ 45,000.
62 KVA DIESEL	2,000.	2,000.	5,000.	13,230.
31 KVA DIESEL	1,000.	1,500.	4,000.	10,500.
LUTES 100 KW HYDRO	2,000.	N/A	N/A	N/A
COVER 65 KW HYDRO	2,000.	N/A	N/A	N/A

DIESEL FUEL CONSUMPTION: 80 to 100% of capacity = .072 gal/kw-hr
50 to 79% of capacity = .104 gal/kw-hr

MINOR OVERHAUL INTERVAL: AT 25,000 AND 75,000 HOURS OPERATING
MAJOR OVERHAUL INTERVAL: AT 50,000 HOURS OPERATING
REPLACEMENT INTERVAL : AT 100,000 HOURS OPERATING

TABLE 7-2

ANNUAL OPERATING CHARACTERISTICS
LUTES AND COVER CREEK DEVELOPMENTS

	KW	% OF YEAR	HRS PER DAY	KW	% OF YEAR	HRS PER DAY	KW	% OF YEAR	HRS PER DAY	KW	% OF YEAR	HRS PER DAY	KW	% OF YEAR	HRS PER DAY	ANNUAL OPERATING HOURS	ANNUAL KW-HRS
LUTES SMALL HYDRO/DIESEL																	
100 KW SMALL HYDRO	100	50%	24	40	25%	24	15	25%	24							8760	564,533
31 KVA DIESEL				25	25%	12	25	25%	12							2190	54,750
TOTALS	100	50%		65	25%		40	25%								N/A	619,283
LUTES DIESEL EQUIVALENT																	
156 KVA DIESEL	100	50%	24	65	25%	24										6570	580,350
62 KVA DIESEL							40	25%	12							1095	43,800
TOTALS	100	50%		65	25%		40	25%								N/A	624,150
COVER SMALL HYDRO/DIESEL																	
65 KW SMALL HYDRO	65	10%	24	48	23%	24	21	17%	24	7	20%	24				6132	205,000
31 KVA DIESEL				25	23%	12										1007	25,175
62 KVA DIESEL							50	17%	12	50	20%	12	50	30%	12	2935	146,730
TOTALS	65	10%		73	23%		71	17%		57	20%		50	30%		N/A	376,905
COVER DIESEL EQUIVALENT																	
62 KVA DIESEL	50	10%	24	50	23%	24	71	17%	12	50	20%	12	50	30%		5825	291,270
31 KVA DIESEL	15	10%	24	25	23%	12	21	17%	24							3372	75,540
TOTALS	65	10%								50	20%		50	30%		N/A	366,810
EXISTING DIESEL																	
62 KVA DIESEL	50	100%	24													4380	219,000

Note* : Basis area under median curve Figure xx and xx, KW determined for power factor 0.8

FIGURE 7-1
COVER CREEK FINANCIAL ANALYSIS

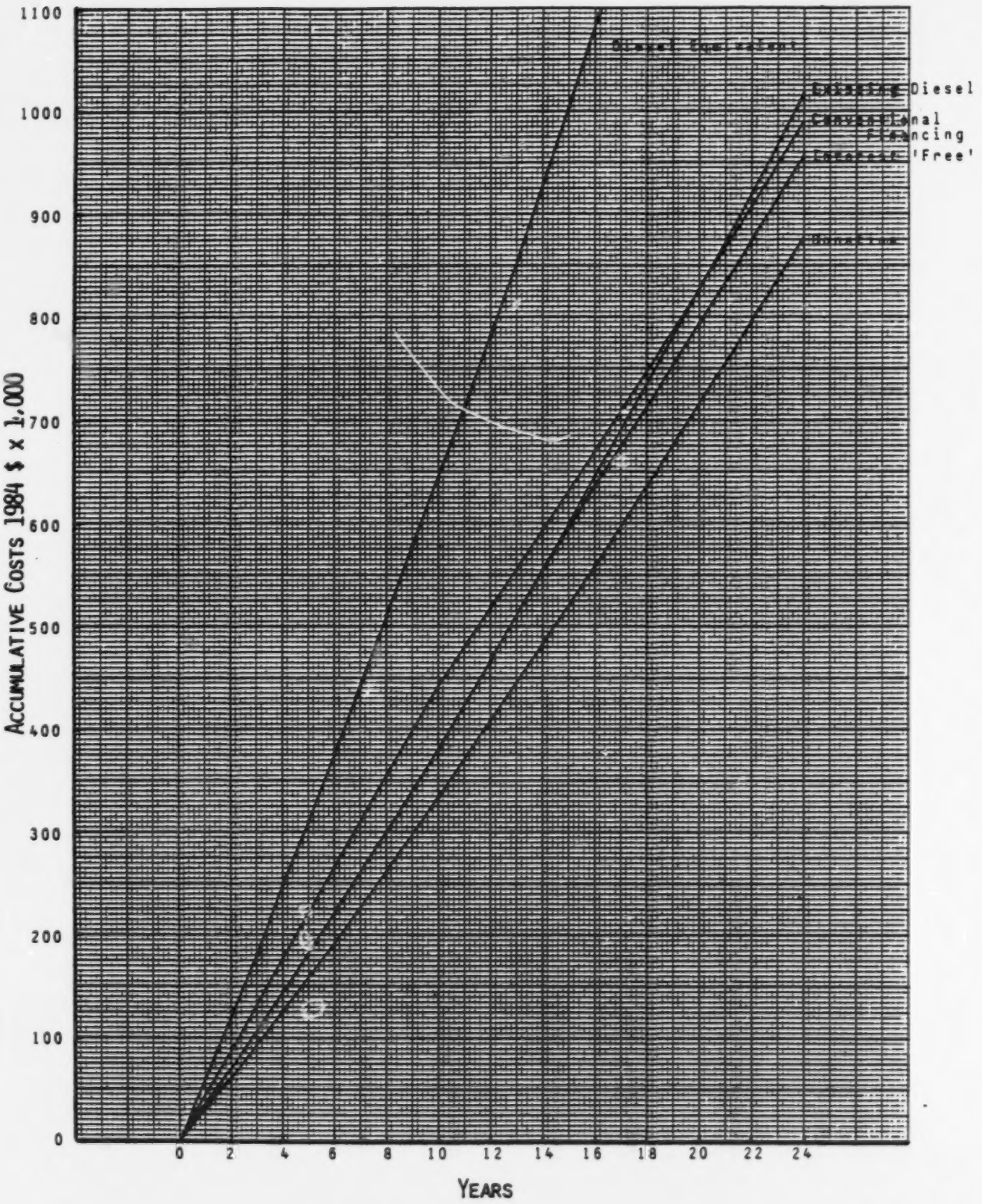


FIGURE 7-2
LUTES CREEK FINANCIAL ANALYSIS

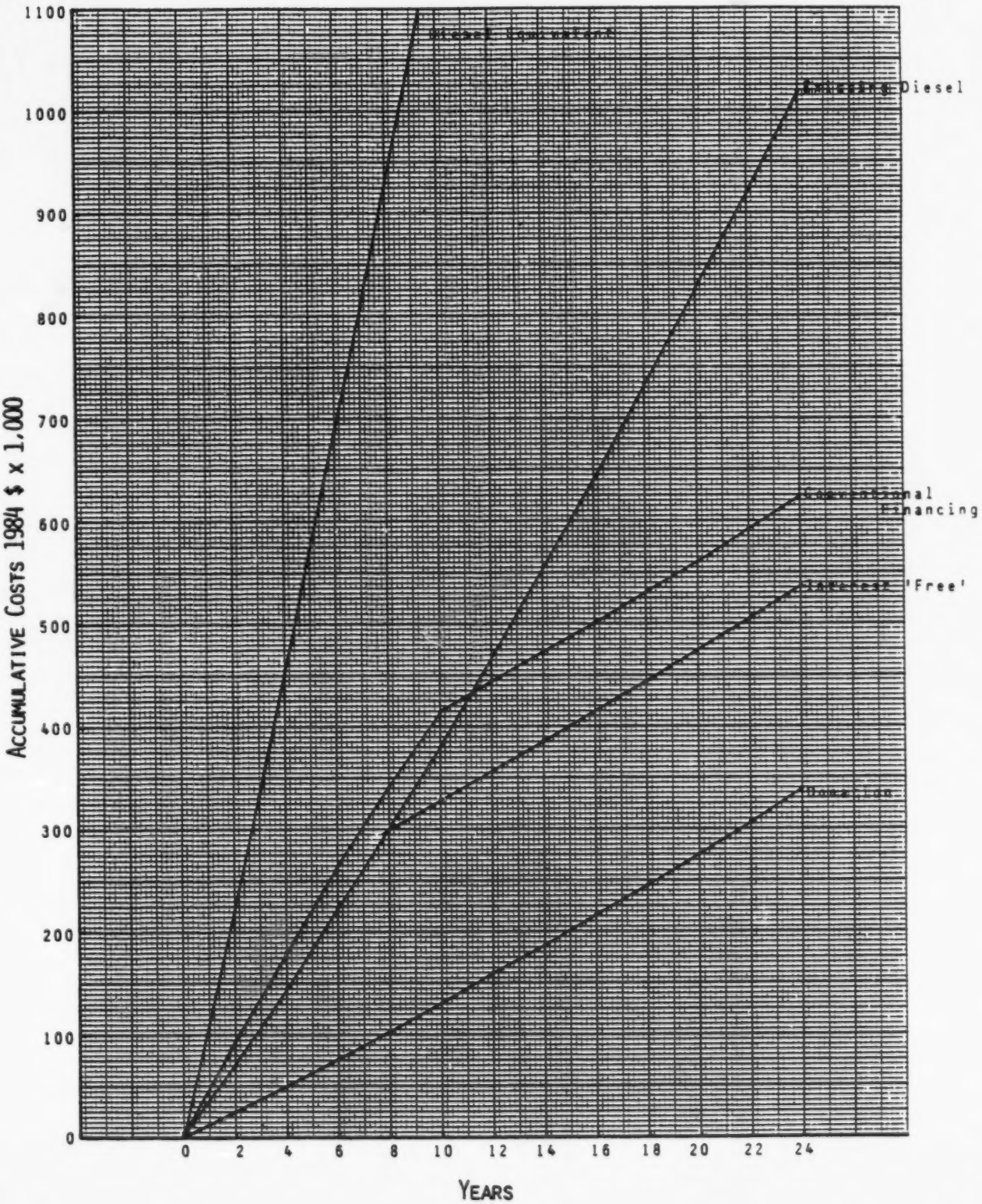


TABLE 7-3

SUMMARY OF FINANCIAL ANALYSIS
LUTES CREEK AND COVER CREEK DEVELOPMENTS
Note* All 1984 dollars.

	TOTAL RUNNING COST AT END OF 24 YEARS	ANNUAL KW-HRS SUPPLIED	AVG. COST PER KW-HR OVER 24 YRS	1ST YEAR OF SAVINGS FOR EXISTING	1ST YEAR OF SAVINGS FOR DIESEL
COVER CREEK SMALL HYDRO/DIESEL					
DIESEL EQUIVALENT					
CONVENTIONAL FINANCING	$ 991,176.	376,905	$ 0.110	20.	1.
INTEREST 'FREE'	957,110.	376,905	0.106	15.	1.
DONATION	879,458.	376,905	0.097	1.	1.
DIESEL EQUIVALENT	1,731,362.	366,810	0.196	N/A	N/A
EXISTING DIESEL	1,019,358.	219,000	0.194	N/A	N/A
LUTES CREEK SMALL HYDRO/DIESEL					
CONVENTIONAL FINANCING	$ 623,506.	619,283	$ 0.042	11.	1.
INTEREST 'FREE'	536,625.	619,283	0.036	8.	1.
DONATION	338,590.	619,283	0.023	1.	1.
DIESEL EQUIVALENT	3,195,173.	624,150	.213	N/A	N/A
EXISTING DIESEL	1,019,358.	219,000	.194	N/A	N/A

8.0 REGULATORY CONSIDERATIONS - LUTES AND COVER CREEKS

8.1 FISHERIES

Lutes Creek is not accessible to marine life of any species because of the 40 ft waterfall which empties directly into Hecate Channel. Neither are there any bodies of water within the watershed.

8.2 FORESTRY

The portion of the Lutes Creek watershed that is of interest here is classified as vacant crown land. There is apparently no chart held on the timber rights. Tahsis Co. does have some long term (5 to 10 years) plans to possibly harvest the top of the watershed. They would enter the watershed by coming over the top from the Tahsis end. This would not interfere in any way with the proposed small hydro development.

8.3 WATER RIGHTS

Water Rights applications have been filed. There are no other existing water rights in the watersheds and there are no apparent difficulties in obtaining these rights along with an easement to ensure access to the areas.

8.4 TRANSPORT CANADA

An application has been filed for approval of the installation of the submarine cable under the Navigable Waters Protection Act. Informal discussions with officers of the ministry indicated that there should be no difficulty in obtaining approval. This must be obtained before the cable can be laid and the approval process can take at least two months. Information of the Navigable Waters Protection Act is provided on pages A15 and A16 of the appendix.

8.5 PROVINCIAL ELECTRICAL INSPECTION BRANCH

The procedure requires approval of the cable specifications by the electrical inspector having jurisdiction in the region. The cable described here in section 6.7 has been approved for similar installations. Informal discussions with the inspection branch indicated that there was no problem apparent. The other electrical aspects of the installation fall under the requirements of the Canadian Electrical Code and inspection by the Electrical Branch is required.

9.0 ENERGY CONSERVATION

9.1 GENERAL COMMENTS

It is difficult to access the economic attractiveness of the various measures that could be adopted to significantly reduce the building heating loads. The community presently burns wood for almost all of its space heating requirements. A lot of the wood is prepared into cord wood by volunteers during the summer months.

The potential savings are substantially qualitative and reflect on things such as lifestyle, fire-hazard, smoke nuisance and comfort. The community has expressed a desire to be less dependant on wood. It is clear in this respect that these subjective considerations are sufficiently compelling that opportunities will be taken to improve conservation as the time and financial resources become available. In the context of this report the alternatives are assessed for their relative impact and capital requirements. Potential savings are discussed where there is a fuel other than wood currently in use.

9.2 DOMESTIC HOT WATER

A summary of the per cent of the total annual operating electrical Kw-hrs represented by type of load is reported in Table 4-1. Domestic hot water accounts for 96,000 Kw-hrs per year, or $14,500. per annum (p.a.) at current fuel rates. This is 45% of the annual diesel load.

The use of alternative fuels such as wood or propane would certainly provide substantial savings. Based on a cost of 40 cents per litre and an overall efficiency of 65%, propane could provide the hot water at 8.5 cents per Kw-hr vs. diesel at 15.1 cents per Kw-hr. These alternatives will be discussed briefly in the following but are implicitly rejected here if the proposed small hydro developments proceed. This is due to the fact that the existing hot water loads are an excellent use for off-peak small hydro power. In fact the domestic hot water would be totally small hydro heated for the Lutes option and approximately 75% small hydro heated even for the smaller Cover Creek option.

The use of wood heat for domestic hot water requires the installation of water jackets into the fireboxes of the existing stoves and range boilers in the vicinity of the stoves to complete the thermosyphon loop. Figure 8-1 depicts a typical installation. Each installation of this type would cost an estimated $450. and could displace 60% of the hot

FIGURE 8-1
TYPICAL WOOD-FIRED DOMESTIC HOT WATER

A wood-plus-conventional water heating system with an intermediary storage tank. This type of installation makes it possible to use natural circulation even when the conventional water heater is far away or lower in elevation than the wood heater. Also, lower temperature, wood-heated water can be utilized which can increase the contribution of the wood system. When the wood heater is not functioning, bypass pipe (1) allows the cold water to enter the conventional water heater directly.

Please note:

This is figure 5-15 (page 115) of WOOD HEAT SAFETY by Jay W. Shelton, published by Garden Way Publishing.

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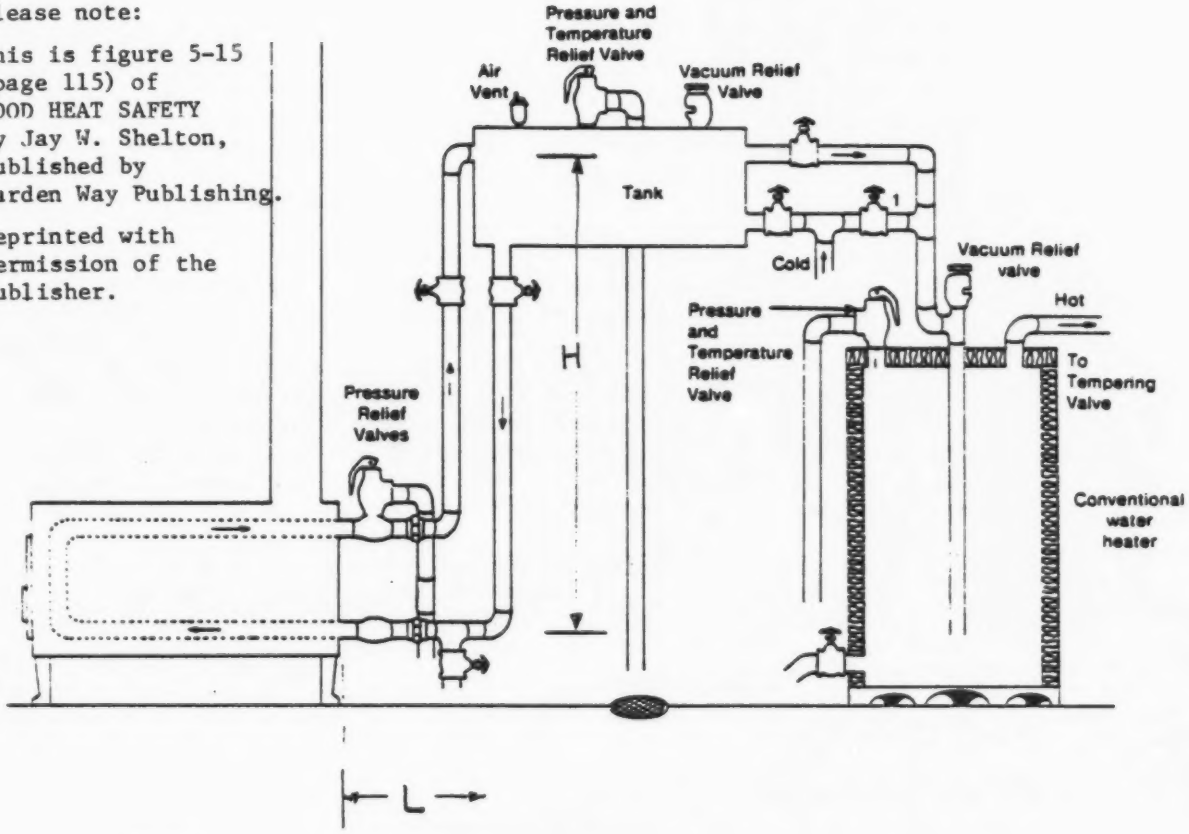


NOTES:

1. The minimum difference in height , H, for adequate thermo-syphoning between the tank and the heat exchanger is determined by this rough rule of thumb - the ratio of L/H should be 2 to 1.

2. The overhead tank should be left uninsulated, and should have a storage volume of 30-50 gallons. A galvanized range boiler is often used in this application.

3. The plumbing between the heat exchanger and the tank should be 3/4". Obstruction to flow should also be minimized by using gate valves and minimizing the number of bends.

water in the colder months when the stoves are in use. This represents a one year simple return on investment.
If propane hot water tanks were installed and heating the water at a cost 8.5 cents per Kw-hr as determined above, the resulting savings would be about $6,336 p.a. or 44% less than the cost of the diesel electricity presently used. This also represents about a one year simple return on the cost of the new propane heaters. This would require nineteen 100 lb. bottles each month and would be most conveniently served if there was propane tankage at the community and a propane marine barge to routinely service it. At the present time there is no such barge service available in the area. Bottles would have to be routinely taken by boat to Tahsis for filling. Alternatively, the Uchuck III ferry service could be used (as is presently done by some logging camps in the area) to routinely take the bottles back and forth.

To upgrade the existing hot water system - as is recommended here in light of the proposed small hydro development - the most effective conservation measure is to add insulation to the existing tanks. Most of the tanks are located in areas of the buildings which are not well heated, if heated at all. Tank insulation kits, or fibreglass insulation with one plastic backing, are available from energy conservation specialty shops, solar panel manufacturers and some building supply centres. Adding 2" of insulation to the outside of these tanks should reduce consumption by 15% and save $2175. p.a. based on diesel generated electricity. The estimated cost to insulate all of the existing tanks is $455.00. The simple return on this investment is 2.5 months. The hot water supply lines are relatively short and the insulation of these would only be warranted where the line passes through an unheated area.

9.3 SPACE HEATING

9.3.1 HEATING EQUIPMENT

Currently, there are three types of space heating systems in use - wood heat, electric baseboard and (two only) oil forced air.

The economic attractiveness of converting the oil to propane is marginal. This is particularly true as long as there is no barge service for bulk propane.

It is likely that there will always be some use of wood for space heating at Esperanza. The existing wood heat installations are adequate. Any shortfall in their performance can be directly attributed to the low level of

insulation and the high level of infiltration in the buildings.

There are two possible changes to the present wood heating arrangement that would result in significant improvements if implemented. These are: 1) better management of the cord wood supply and 2) the use of retrofit catalytic combustors to enhance overall efficiency and reduce the risk of chimney fires.

Poor planning and a lack of proper facilities for wood seasoning result in the frequent use of green wood. Properly seasoned wood will provide twice the heat per lb. of wood burned and reduce the amount of creosote produced. A wood shed has been partially completed which will provide for better seasoning. In late spring or early summer (the earlier the better) the cord wood for the winter should be cut, split and stacked to season in a sheltered location over the summer and fall. Allowance should be made for about six full cords per household if wood is the primary source of heat.

Catalytic combustors that can be added on to existing wood heaters have demonstrated 15 to 20% increases in heat output per lb. of wood burned and a reduction of more than 75% in creosote (see WOOD'n ENERGY, March 1984). They have been available commercially for three years. At an initial cost of $225. and replacement of the catalyst every two or three years at a $100. cost, the economics would be attractive if the wood was being purchased. Since the wood is virtually free, the evaluation is more complex and must consider these qualitative aspects discussed earlier in section 7.1. However, the most compelling aspect is not the wood savings but the tremendously reduced probability of a chimney fire occurring. This is particularly of consequence to remote communities which typically have limited access to both fire protection and insurance.

9.3.2 INSULATION

The community would qualify for funding under the CHIP home insulation program sponsored by Energy Mines and Resources Canada (EMR). This would provide a subsidy of 60% of the cost of materials and labour up to a total subsidy of $500. The subsidy would allow the purchase of $835. of insulation materials per home and the net cost would be $335. assuming it was owner-installed and that they insulate to at least R34 in the ceilings (a requirement of the program).

The walls only have 3.5" of void to fill. The most expedient

method to do this is to use loose-fill cellulose insulation which will achieve an R12 level of wall insulation. It can be blown in between the studs through holes cut in the inside or outside walls for access. The blowing equipment can be rented. Care must be taken to closely follow the proper procedures to ensure an effective job is done. In this case there would be no vapour barrier against the inside wall and it becomes necessary to seal the wall by painting with a good coat of oil-based paint or by using a special 'vapour barrier' paint such as INSULAID by Glidden. Draft stopper gaskets should also be installed behind electrical receptacle covers on exterior walls.

The materials cost for R40 (12" deep) glass fibre batt insulation is 85 cents per sq. ft. The loose fill cellulose insulation for the walls would cost 18 cents per sq. ft. of outside wall. Using the CHIP subsidy the net cost to the owner to insulate a 20 by 45 ft bungalow (which is typical of homes at Esperanza) would be $450. This would reduce the energy required for space heating by an estimated 33% (13% from walls and 20% from ceiling). If all the recommendations for energy conservation presented here were implemented, then it would be likely that most of the homes could be entirely electrically heated if the Lutes small hydro option were developed. Information bulletins provided by EMR on these types of insulation materials are included on pages A17 to A20 of the appendix.

Any new residences to be built at the community should be constructed to the R2000 level of energy conservation. The details on the R2000 program are available through EMR's Vancouver office. Homes built to this standard will require 70 to 80% per cent less energy for space heating as compared to homes insulated to the levels discussed above. As more homes are built at Esperanza, it will be important to use the electricity more exclusively for the services that have no other energy alternative such as appliances and lighting. Energy conservation will become increasingly important with each expansion.

9.4 LIGHTING

The community should continue with its program to convert more of the incandescent lighting to fluorescent. However, it is acknowledged that some people will find fluorescent lighting undesirable in a home environment. There is about 4 Kw of existing incandescent lighting in buildings C-1, C-2 and the school house that should be converted. This would save 3 Kw of power in lighting or $900 p.a. based on diesel generated electricity.

9.5 WINDOWS

Do-it-yourself plastic storm window kits are available as an inexpensive means of reducing heat loss through windows by 50%. All of the buildings presently use single pane glass. The cost is about $1. per sq. ft. of window area. This would reduce the energy required for heating by 10% when compared to the existing requirements.

10.0 CONCLUSIONS

1. The development of Cover Creek is attractive only if the 'Diesel Equivalent' comparison is accepted as representative, or if the funds are 'Donated' - meaning they will not have to be repaid. Either one of the preceding will result in a savings for the community from the very first year and onward. The 'Diesel Equivalent' case should be more representative of the Cover Creek development. The proposed hydro plant is close enough in size to the actual existing load that it is likely that Esperanza will quickly reach the point that every Kw-hr is producing a savings against the diesel.

2. The development of Lutes Creek is attractive for all cases considered here. The savings are summarized graphically in Figure 7-2 and are reported in Table 7-3. Even the 11 year wait for actual 'project to date' savings for the case of 'Conventional Financing' compared against the Existing Diesel costs is attractive. Table A-11 of the appendix demonstrates that after only six years in this scenario the yearly payments become less for the Lutes development than they would be for the 'Existing Diesel' - and there is only $40,000 to recover in losses in the first six years.

11.0 RECOMMENDATIONS

1. The Nootka Mission Association (NMA) should begin actively pursuing the opportunities for assistance under phase II of the RCDP program. The opportunities for conventional financing should be investigated. Simultaneously, a program should be developed to promote the project to potential supporting foundations, churches etc. as an opportunity for Esperanza to become virtually energy independent and to have surplus power for growth and new actvities. It would also allow more of the funds from these supporting agencies to be used for expanding the social service objectives of the mission rather than 'pouring' it away into fuel.

   NMA should appoint a representative to actively follow up progress with the Water Rights and Transport Canada applications.

2. The opportunities for energy conservation as discussed in section 9.0 should be acted upon. Of particular priority is the hot water tank insulation, the installation of catalytic combustors on the woodstoves and the home insulation provided by the CHIP program. All of these have good returns when the impact on lifestyle and comfort is considered along with the financial savings.

3. If the community appears to be unable to raise the funds for the Lutes Creek development after two years then serious consideration should be given to the development of Cover Creek at that time. By exploiting every opportunity to reduce the peak power requirement - such as converting to propane or fuel oil for hot water heating , propane on the clothes dryers and the use of flourescent lighting throughout - the attractiveness of Cover Creek will be enhanced.

Appendix 1

PARTIAL LISTING OF SUPPLIERS

ITEMS	ADDRESS	
TRANSMISSION CABLE	CANADA WIRE 1066 W. HASTINGS VANCOUVER, B.C.	PHONE: 687-8551 CONTACT: D. MACLEAN
	ANIXTER CANADA 4255 PHILLIPS BURNABY, B.C.	PHONE: 420-5606 CONTACT: PETER - SALES
	PIRELLI CABLES 13891 VIKING WAY RICHMOND, B.C.	PHONE: 273-5255 CONTACT: BOB WOLFE
PIPE	DUPONT OF CANADA 1550 ALBERNI VANCOUVER, B.C.	PHONE: 684-9264 CONTACT: PAUL ROSS
	FABRICATED PLASTICS 7531 - 134 A ST. SURREY, B.C.	PHONE: 591-8204 CONTACT: KEN - SALES
	INTERNATIONAL PLASTICS 12180 VICKERS WAY RICHMOND, B.C.	PHONE: 273-4987
	SCEPTER MFG. 731 DERWENT WAY ANNACIS ISLAND, B.C.	PHONE: 525-8621
TRANSFORMERS	BEAVER ELECTRIC 7440 LOWLAND BURNABY, B.C.	PHONE: 438-5201
	NEDCO 3500 VIKING WAY RICHMOND, B.C.	PHONE: 273-2244

GABIONS	MACCIFERRI GABIONS 736 GRANVILLE VANCOUVER, B.C.	PHONE: 683-4824 CONTACT: BARTH PERONE

PARTIAL LIST OF SUPPIERS - CONT'D

ITEM	SUPPLIER	
SMALL HYDRO POWERPLANTS	CANYON INDUSTRIES 5342 MOSQUITO LAKE RD. DEMING, WASHINGTON 98244	PHONE: (206)592-5552 CONTACT: DAN NEW
	LITTLE SPOKANE HYDRO P.O. BOX 82 CHATTAROY, WASHINGTON 99003	PHONE: (509)238-6810 CONTACT: MIKE JOHNSTON
	DEPENDABLE TURBINES 7 - 3005 MURRAY PT. MOODY, B.C.	PHONE: 461-3121 CONTACT: R. PRIOR
	THE ENERGY CENTRE 4025 E HASTINGS BURNABY, B.C.	PHONE: 291-0342 CONTACT: DOUG REMPEL
	SMALL HYDROELECTRICS 5141 WICKERSHAM ACME, WASHINGTON 98220	PHONE: (206)595-2312 CONTACT: BILL KITCHING
ELECTRONIC LOAD CONTROL AND LOAD MANAGEMENT	THOMSON AND HOWE ENERGY BOX 2, SITE 17 SS # 1 KIMBERLEY, B.C.	PHONE: 427-4326 CONTACT: BILL THOMSON

Appendix 2

TABLE A-1

RAINFALL AND FLOW DATA FOR WEIR IN COVER CREEK

Day	March		April		May	
	Flow C.F.S.	Rainfall m.m.	Flow C.F.S.	Rainfall m.m.	Flow C.F.S.	Rainfall m.m.
1			m	40.4	m	0.4
2			m	30.0	0.29	0.6
3			m	0	0.29	1.0
4			m	0	0.29	1.0
5			m	0	m	2.2
6			3.1	3.2	0.29	36.0
7			m	1.2	0.37	6.2
8			m	0.2	0.37	17.4
9			m	5.2	m	0.3
10			m	0	1.85	0
11			1.3	0	0.67	0
12			1.1	0	0.45	0
13			0.93	0	0.45	5.2
14			0.80	0	0.45	2.6
15			0.67	0	0.45	0.8
16			m	0	0.45	2.6
17			0.67	0	0.56	3.6
18			m	0	0.45	0
19			0.45	3.6	0.37	0
20			m	13.0	m	0
21			0.45	0	m	0
22			0.56	0	m	0
23	0.93	12.2	0.45	0	m	0
24	0.93	0	0.45	9.4	m	0
25	m	10.0	0.45	4.2	0.23	0
26	m	10.0	0.56	3.0	0.23	0
27	m	10.0	0.45	0	0.23	0
28	3.1	13.2	0.37	0	0.23	0
29	m	55.4	0.37	0	m	0
30	m	16.2	0.37	0	m	0
31	m	17.4	-	-	m	0

m = missing data

TABLE A-2

RAINFALL AND FLOW DATA FOR WEIR IN COVER CREEK

Day	July		August		November	
	Flow C.F.S.	Rainfall m.m.	Flow C.F.S.	Rainfall m.m.	Flow C.F.S.	Rainfall m.m.
1			0.45	13.4		
2			0.56	12.6		
3			0.67	1.8		
4			0.67	0		
5			0.56	0		
6			0.45	0		
7			0.45	0		
8			0.35	0		
9			0.29	0		
10			0.29	0		
11						
12						
13						
14					4.49	m
15					5.70	65.0
16					7.08	45.0
17					10.0+	95.0
18					6.14	25.0
19					4.49	5.0
20					3.78	0
21					2.57	0
22					2.07	6.0
23					1.63	11.0
24					2.57	16.0
25					1.85	1.0
26					3.78	30.0
27					3.78	0
28	0.93	0			2.57	0
29	0.75	0			1.85	0
30	0.56	1.5			1.50	0
31	0.45	1.5			-	-

m = missing data

TABLE A-3

STATISTICAL SUMMARY OF HISTORICAL TAHSIS PRECIPITATION RECORDS

REF 101.01331.801 BEGAN OCT 1952 1037890 TAHSIS 9C
REF 101.01331.801 DEBUT OCT 1952 1037890 TAHSIS C-9

TOTAL RAINFALL (MILLIMETRES)
CHUTES DE PLUIE TOTALES (MILLIMETRES)

YEAR	JAN JAN	FEB FEV	MAR MARS	APR AVR	MAY MAI	JUN JUIN	JUL JUIL	AUG AOUT	SEP SEPT	OCT OCT	NOV NOV	DEC DEC	ANNUAL ANNUELLE	ANNEE
PERIOD OF RECORD/PERIODE DES RELEVES														
MEAN	436.1	396.4	341.2	252.4	142.1	119.6	91.0	114.5	269.9	482.4	509.1	605.0	3759.7	MOYENNE
STD.DEV.	262.7	183.6	152.8	125.3	89.4	70.6	66.2	80.2	113.2	243.2	221.7	224.8	805.4	ECART-TYPE
# OF YEARS	28	28	28	27	27	28	26	27	26	26	28	29		DONNEE ANNEES
PERCENTILES														PERCENTILES
95% <	891.9	690.4	644.8	467.9	376.5	244.3	228.6	293.2	536.7	1006.6	1068.2	1028.0	4646.7	95%
75% <	677.5	496.3	452.5	325.4	164.1	182.1	140.4	162.1	333.6	617.9	595.5	756.8	4221.0	75%
50% <	365.1	353.9	343.3	241.3	133.9	106.4	85.6	90.2	253.2	486.6	463.6	669.8	3977.9	50%
25% <	223.4	247.0	232.2	133.0	77.7	44.6	37.2	53.6	174.3	252.0	372.5	391.7	3143.3	25%
5% <	28.0	158.1	43.6	74.7	34.4	24.2	2.1	20.0	130.8	153.7	251.5	229.3	2712.1	5%
		CODE 2				NORMALS/NORMALES 1951-80						CODE 2		
MEAN	436.1	396.4	341.2	252.4	142.1	119.6	91.0	114.5	269.9	482.4	509.1	605.0	3759.7	MOYENNE
STD.DEV.	262.7	183.6	152.8	125.3	89.4	70.6	66.2	80.2	113.2	243.2	221.7	224.8	805.4	ECART-TYPE
# OF YEARS	30	28	28	27	27	28	26	27	26	28	28	29		DONNEE ANNEES
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL	
	JAN	FEV	MARS	AVR	MAI	JUIN	JUIL	AOUT	SEPT	OCT	NOV	DEC	ANNUELLE	

Appendix 4

TABLE A-4

COMPOSIT EXPECTED LENGTH OF TIME FOR REQUIRED FLOWS OVER WEIR IN COVER CREEK FOR 25 PERCENTILE RAINFALL YEAR.

	Curve No	% Of Month Expected For Flows Of				
		0.5 C.F.S.	1.0 C.F.S.	2.0 C.F.S.	3.6 C.F.S.	5.0 C.F.S.
Jan	2	68	46	33	19	12
Feb	2	68	46	33	19	12
March	2	68	46	33	19	12
April	3	12	5	0	0	0
May	3	12	5	0	0	0
June	0	0	0	0	0	0
July	0	0	0	0	0	0
Aug	0	0	0	0	0	0
Sep	2	68	46	33	19	12
Oct	2	68	46	33	19	12
Nov	2	68	46	33	19	12
Dec	1	100	100	76	45	17
% Of Time In Months		532	386	274	159	89
% Of Time Of Year		44	32	23	13	7

TABLE A-5

COMPOSIT EXPECTED LENGTH OF TIME FOR REQUIRED FLOWS OVER WEIR IN COVER CREEK FOR 50 PERCENTILE RAINFALL YEAR.

	Curve No	% Of Month Expected For Flows Of				
		0.5 C.F.S.	1.0 C.F.S.	2.0 C.F.S.	3.6 C.F.S.	5.0 C.F.S.
Jan	2	68	46	33	19	12
Feb	2	68	46	33	19	12
March	2	68	46	33	19	12
April	2	68	46	33	19	12
May	3	12	5	0	0	0
June	3	12	5	0	0	0
July	3	12	5	0	0	0
Aug	3	12	5	0	0	0
Sep	2	68	46	33	19	12
Oct	1	100	100	76	45	17
Nov	1	100	100	76	45	17
Dec	1	100	100	76	45	17
% Of Time In Months		688	596	393	230	111
% Of Time Of Year		57	50	33	19	9

TABLE A-6

COMPOSIT EXPECTED LENTGH OF TIME FOR REQUIRED FLOW OVER WEIR IN COVER CREEK FOR 75 PERCENTILE RAINFALL YEAR.

	Curve No	% Of Month Expected For Flows Of				
		0.5 C.F.S.	1.0 C.F.S.	2.0 C.F.S.	3.6 C.F.S.	5.0 C.F.S.
Jan	1	100	100	76	45	17
Feb	1	100	100	76	45	17
March	1	100	100	76	45	17
April	2	68	46	33	19	12
May	3	12	5	0	0	0
June	2	68	46	33	19	12
July	3	12	5	0	0	0
Aug	3	12	5	0	0	0
Sep	2	68	46	33	19	12
Oct	1	100	100	76	45	17
Nov	1	100	100	76	45	17
Dec	1	100	100	76	45	17
% Of Time In Months		840	753	555	327	138
% Of Time Of Year		70	63	46	27	12

TABLE A-7
DETAILED FINANCIAL ANALYSIS FOR EXISTING DIESEL 62 KVA

YEAR	FUEL COST PER GAL.	COST OF FUEL 15768 GAL.	O&M	YEARLY RUNNING COSTS	ΣYEARLY RUNNING COSTS	REPLACEMENT LOANS	ALL YEARLY COSTS	ΣALL YEARLY COSTS'
1	2·1315	33609	2000	35609	35609	–	–	–
2	2·1635	34114	2000	36114	71723	–	–	–
3	2·1959	34625	2000	36625	108348	–	–	–
4	2·2289	35145	2000	37145	145493	–	–	–
5	2·2623	35672	2000	37672	183165	–	–	–
6	2·2962	36207	4000	40207	223372	–	–	–
7	2·3307	36750	2000	38750	262122	–	–	–
8	2·3656	37301	2000	39301	301423	–	–	–
9	2·4011	37861	2000	39861	341284	–	–	–
10	2·4371	38429	2000	40429	381713	–	–	–
11	2·4737	39005	2000	41005	422718	–	–	–
12	2·5108	39590	7000	46590	469308	–	–	–
13	2·5485	40184	2000	42184	511492	–	–	–
14	2·5867	40787	2000	42787	554279.	–	–	–
15	2·6255	41399	2000	43399	597678	–	–	–
16	2·6649	42020	2000	44020	641498	–	–	–
17	2·7049	42650	2000	44650	686348	–	–	–
18	2·7454	43290	4000	47290	733638	–	–	–
19	2·7866	43939	2000	45939	779577	–	–	–
20	2·8284	44598	2000	46598	826175	–	–	–
21	2·8708	45267	2000	47267	873442	–	–	–
22	2·9139	45946	2000	47946	921388	–	–	–
23	2·9576	46635	2000	48635	970023	–	–	–
24	3·0020	47335	2000	49335	1019358	–	–	–

TABLE A-8
DETAILED FINANCIAL ANALYSIS FOR COVER CREEK EQUIVALENT DIESEL

YEAR	FUEL COST PER GAL.	COST OF FUEL 26,113 GAL.	O&M	YEARLY RUNNING COSTS	ΣYEARLY RUNNING COSTS	REPLACEMENT LOANS	ALL YEARLY COSTS	ΣALL YEARLY COSTS'
1	2·1315	55659	4000	59659	59659	–	–	59659
2	2·1635	56494	4000	60494	120154	–	–	120154
3	2·1959	57342	4000	61342	181496	–	–	181496
4	2·2289	58202	9000	67202	248699	–	–	248699
5	2·2623	59075	4000	63075	311774	–	–	311774
6	2·2962	59961	4000	63961	375735	–	–	375735
7	2·3307	60860	4000	64860	440596	–	–	440596
8	2·3656	61773	8000	69773	510370	–	–	510370
9	2·4011	62700	4000	66700	577071	–	–	577071
10	2·4371	63640	4000	67640	644711	–	–	644711
11	2·4737	64595	4000	68595	713307	–	–	713307
12	2·5108	65564	4000	69564	782871	–	–	782871
13	2·5486	66547	4000	70547	853419	2544	73091	855963
14	2·5867	67546	4000	71546	924966	2423	73968	929932
15	2·6255	68559	4000	72559	997525	2307	74866	1004799
16	2·6649	69587	11000	80587	1078113	2197	82785	1087584
17	2·7048	70631	4000	74631	1152744	2093	76724	1164308
18	2·7454	71691	4000	75691	1228435	1993	77684	1241992
19	2·7866	72766	4000	76766	1305202	1898	78664	1320657
20	2·8284	73857	9000	82857	1388060	1808	84665	1405323
21	2·8708	74965	4000	78965	1467025	1722	80687	1486010
22	2·9139	76090	4000	80090	1547116	1640	81730	1567740
23	2·9576	77231	4000	81231	1628347	–	–	1628347
24	3·0020	78390	4000	82390	1710738	–	–	1731362

TABLE A-9
DETAILED FINANCIAL ANALYSIS FOR COVER CREEK SMALL HYDRO/DIESEL

YEAR	FUEL COST PER GAL.	COST OF FUEL 12378 GAL	O&M	YEARLY RUNNING COSTS	Σ YEARLY RUNNING COSTS	REPLACEMENT LOANS	ALL YEARLY COSTS	Σ ALL YEARLY COSTS
1	2·1315	26384	5000	31384	31384	13779	45163	45163
2	2·1635	26779	5000	31779	63163	13123	44902	90065
3	2·1959	27181	5000	32181	95344	12498	44679	134744
4	2·2289	27589	5000	32589	127933	11903	44492	179236
5	2·2623	28003	5000	33003	160936	11336	44339	223575
6	2·2962	28423	5000	33423	194359	10796	44219	267794
7	2·3307	28849	5000	33849	228208	10282	44131	311925
8	2·3656	29282	5000	34282	262490	9793	44074	355999
9	2·4011	29721	5000	34721	297211	9326	44047	400047
10	2·4371	30167	5000	35167	332378	8882	44049	444096
11	2·4737	30619	5000	35619	367997	–	–	479715
12	2·5108	31079	9000	40079	408076	–	–	519794
13	2·5486	31545	5000	36545	444620	–	–	556338
14	2·5867	32018	5000	37018	481638	–	–	593356
15	2·6255	32498	5000	37498	519137	–	–	630855
16	2·6649	32986	5000	37986	557122	–	–	668840
17	2·7048	33481	5000	38481	595603	–	–	707321
18	2·7454	33983	5000	38983	634586	–	–	746304
19	2·7866	34492	5000	39492	674078	–	–	785796
20	2·8284	35010	5000	40010	714088	–	–	825806
21	2·8708	35535	5000	40535	754623	–	–	866341
22	2·9139	36068	5000	41068	795691	–	–	907409
23	2·9576	36609	5000	41609	837300	–	–	949018
24	3·0020	37158	5000	42158	879458	–	–	991176

TABLE A-10
DETAILED FINANCIAL ANALYSIS FOR LITES CREEK DIESEL EQUIVALENT

YEAR	FUEL COST PER GAL.	COST OF FUEL 49,358 GAL	O&M	YEARLY RUNNING COSTS	Σ YEARLY RUNNING COSTS	REPLACEMENT LOANS	ALL YEARLY COSTS	Σ ALL YEARLY COSTS'
1	2·1315	105206	4000	109206	109206	–	–	109,206
2	2·1635	106784	4000	110784	219991	–	–	219,991
3	2·1959	108386	4000	112386	332377	–	–	332,377
4	2·2289	110012	12000	122012	454390	–	–	454,390
5	2·2623	111662	4000	115662	570052	–	–	570,052
6	2·2963	113337	4000	117337	687389	–	–	687,389
7	2·3307	115037	4000	119037	806427	–	–	806,427
8	2·3656	116763	7000	123763	930190	–	–	930,190
9	2·4011	118514	4000	122514	1052704	–	–	1,052,704
10	2·4371	120292	4000	124292	1176996	–	–	1,176,996
11	2·4737	122096	4000	126096	1303093	–	–	1,303,093
12	2·5108	123928	6000	129928	1433021	–	–	1,433,021
13	2·5485	125786	4000	129786	1562808	7984	137771	1,568,792
14	2·5867	127673	4000	131673	1694481	7604	139278	1,708,071
15	2·6255	129588	4000	133588	1828070	7242	140831	1,848,902
16	2·6649	131532	7000	138532	1966603	6897	145430	1,994,332
17	2·7048	133505	4000	137505	2104108	6569	144074	2,138,407
18	2·7454	135508	4000	139508	2243617	6256	145764	2,284,171
19	2·7866	137540	4000	141540	2385157	5958	147499	2,431,670
20	2·8284	139603	12000	151603	2536761	5674	157278	2,588,949
21	2·8708	141698	4000	145698	2682459	5404	151102	2,740,051
22	2·9139	143823	4000	147823	2830283	5147	152970	2,893,022
23	2·9576	145980	4000	149980	2980264	–	–	3,043,003
..	3·0020	148170	4000	152170	3132434	–	–	3195173

TABLE A-11
DETAILED FINANCIAL ANALYSIS FOR LUTES CREEK SMALL HYDRO/DIESEL

YEAR	FUEL COST PER GAL.	COST OF FUEL 3942 GAL.	O&M	YEARLY RUNNING COSTS	ΣYEARLY RUNNING COSTS	REPLACEMENT LOANS	ALL YEARLY COSTS	ΣALL YEARLY COSTS'
1	2·1315	8402	4000	12402	12402	35141	47543	47543
2	2·1635	8528	4000	12528	24931	33468	45996	93539
3	2·1959	8656	4000	12656	37587	31874	44530	138070
4	2·2289	8786	4000	12786	50373	30356	43142	181212
5	2·2623	8918	4000	12918	63291	28911	41829	223040
6	2·2962	9052	4000	13052	76343	27534	40586	263626
7	2·3307	9188	4000	13188	89531	26223	39410	303036
8	2·3656	9325	4000	13325	102856	24974	38299	341334
9	2·4011	9465	4000	13465	116321	23785	37250	378585
10	2·4371	9607	4000	13607	129928	22652	36259	414845
11	2·4737	9751	4000	13751	143680	–	–	428596
12	2·5108	9898	6000	15898	159577	–	–	444494
13	2·5485	10046	4000	14046	173623	–	–	458540
14	2·5867	10197	4000	14197	187820.	–	–	472736
15	2·6255	10350	4000	14350	202170	–	–	487086
16	2·6649	10505	4000	14505	216674	–	–	501591
17	2·7048	10662	4000	14662	231336	–	–	516254
18	2·7454	10822	4000	14822	246159	–	–	531076
19	2·7866	10985	4000	14985	261144	–	–	546061
20	2·8284	11149	4000	15149	276294	–	–	561210
21	2·8708	11317	4000	15317	291610	–	–	576527
22	2·9139	11487	4000	15487	307097	–	–	592014
23	2·9576	11659	4000	15659	322759	–	–	607672
24	3·0020	11834	4000	15834	338590	–	–	623506

FIGURE A-1

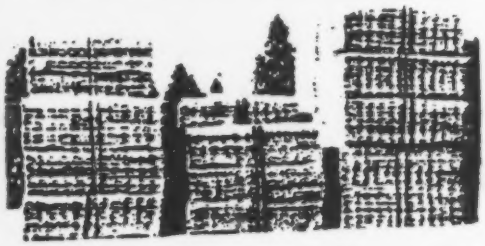
ASSEMBLY AND INSTALLATION OF GABION BASKETS

Information sheet from Macciferri Gabions

PACKING

For ease of handling and shipping the gabions are supplied folded flat.
See picture 1.

A colour stripe applied on the side of each folded gabion identifies the size.
See Picture & table n° 1



Picture No. 1

Assembly

1) Open the bundle and unfold each unit.
2) Lift the sides, the ends and diaphragms into vertical position. Fig. 2.
3) Wire the four corners together and the edges of the diaphragms to the gabion sides. Fig. 2 and 3.

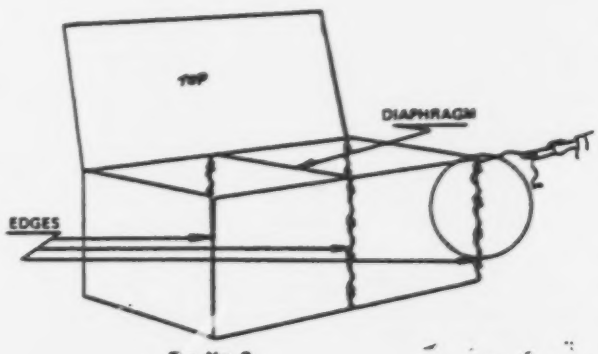


Fig. No. 2

Picture No. 4

Fig. No. 3

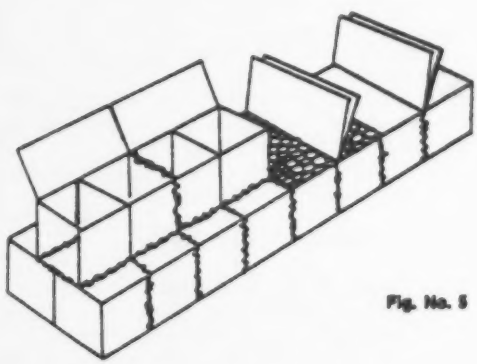


Fig. No. 5

Installation

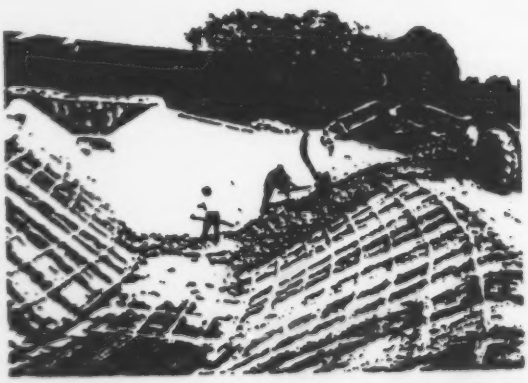
1) Level the base where the gabions will be placed to a smooth finish and the right elevation. See picture n°4.

2) Each unit should be securely wired to the adjacent units along the top and the vertical edges prior to placing the 3" to 8" stone. To achieve better alignment and finish, the gabions can be stretched before filling.

3) Where permitted by the thickness of the structure, the gabions can be placed back to back and front to front to facilitate the filling and closing of the lids. Fig. 5

4) After filling has been completed, the top is folded shut and wired to the ends, side and diaphragms. Fig. 6

5) Empty gabions placed on top of a completed row must be wired to the filled gabions at front and back. Fig. 5



Picture No. 5

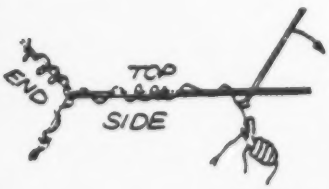


Fig. No. 6

Guide to Navigable Waters Legislation

Appendix 7

1. WHAT STRUCTURES AND ACTIVITIES IN NAVIGABLE WATERWAYS ARE SUBJECT TO THE ACT?

In determining whether your work is subject to the Navigable Waters Protection Act and Navigable Waters Works Regulations, the following examples of works that are subject may be of assistance to you:

(a) any bridge, causeway, trestle, culvert, dam, boom, wharf, dock, jetty, breakwater, retaining wall, gabion wall, barge platform, slipway, pier, ferry terminal facility, tunnel, floating raft, ski jump platform, marina facility, weir, log boom tie-up, piles, dolphins, and mooring buoy; including any approaches or other works necessary or appurtenant thereto;

(b) any excavation or dredging of material, including sand and gravel removal from the bed of a navigable water and dumping or disposal of sand material below high water; dumping of any material likely to contain sediment (i.e. snow dumping in navigable waterways);

(c) any overhead and submarine telegraph or power cable, or wire, pipelines for gas, oil or solids, water pipes, water intake and outfall structures, sewer pipes or outlets;

(d) any scientific towers or artificial islands constructed for the development of natural resources; monopod drilling equipment, stationary oil and gas drilling platforms, well capping equipment;

(e) any structure, device or thing, whether similar in character to those referred to in this paragraph or not, that may interfere with navigation.

2. WHAT IS THE DEFINITION OF NAVIGABLE WATERS?

"Navigable Waters" includes any body of water capable, in its natural state, of being navigated by floating vessels of any description for the purpose of transportation, recreation or commerce; it also includes a canal and any other body of water created or altered for public use, as a result of the construction of any work, as well as any waterway where the public right of navigation exists by dedication of the waterway for public purposes, or by the public having acquired the right to navigate through long use.

NOTE: The preceding definition is used for administrative purposes only and is not to be construed as a legal definition of navigability; navigability is a matter of fact and not of law. The authority to determine navigability of waterways rests with the Minister of Transport.

3. GENERAL INFORMATION

3.1 HOW TO MAKE APPLICATION

Application under the Navigable Waters Protection Act is normally made by letter, which should describe the nature and extent of the work, its location, and anticipated time of construction. It should be accompanied by *ten* copies of the plans of the proposed work, in sufficient detail to show the extent of the project below high water mark. Although we do not provide a standard application form, you will find on page 16 a suggested format for your letter; it is not imperative, however, that it follow precisely the wording indicated.

To expedite your application you may forward *five* copies of your plans to the Chief, Navigable Waters Protection Act Programs Division, Canadian Coast Guard, Department of Transport, 6th Floor, Tower "A", Place de Ville, Ottawa, Ontario, K1A 0N7, and *five* copies to the appropriate Canadian Coast Guard Office. See pages 5 – 6 listing Regional and District Offices and their respective areas of jurisdiction.

4. TYPES OF APPLICATIONS

4.1 FORMAL APPROVAL – Section 5(1) of the Act

Section 5(1) of the Act stipulates that works such as bridges, booms, dams, causeways or works, which are considered to substantially interfere with navigation, be processed as requiring formal approval which involves the *registration of plans* and *advertising*. (See detachable letter of application).

4.1.1 Plan Requirements – (see examples)

(a) Plans of the proposed or "as constructed" work must give sufficient detail (dimensions, cross-section of the work), and be drawn to scale, to enable officials of the Canadian Coast Guard to ascertain the effects of the work on navigation;

(b) Site plan is to be provided;

(c) Ten copies of the plans of the proposed work are required, one copy bearing the certificate and signature of the local Registrar of Deeds or Land Titles Office. (Dimensions – 210 mm x 297 mm (8¼" x 11¾" minimum.)

NOTE: Charts and plans showing the location, extent and character of the work are an essential part of an application. Parties desiring to do major work in navigable waters are advised to consult with our District or Regional officials to avoid the unnecessary expense of preparing plans for major works that would, in some geographical locations of Canada, not meet the requirements of the Canadian Coast Guard. See list of Regional and District Offices, (Pages 5 – 6).

4.1.2 Advertising

(a) To avoid unnecessary advertising expenses, it is suggested that you do not advertise until officials of the Canadian Coast Guard have had the opportunity to investigate the application and the Chief, Navigable Waters Protection Act Programs Division of the Canadian Coast Guard has advised you that the Department is willing to recommend approval of the site and plans. Otherwise, if alterations must be made in the said plans, it will be necessary to re-advertise.

(b) When required, advertising must be done *after* the *final* description and plans have been deposited with the Navigable Waters Protection Act Programs Division of the Canadian Coast Guard and the Registrar of Deeds.

(c) The advertisement should be drawn up as per the form on page 2 inserted once in the legal section of two local newspapers and the Canada Gazette. Address for the Canada Gazette is: Chief, Canada Gazette Division, Printing Operations, Supply & Services Canada, Printing Bureau Building, Hull, Quebec. K1A 0S7

(d) Proof of Advertising by statutory declaration is required. Forms for this purpose may be obtained without charge from the Department of Transport.

NOTE: If changes in the plans are to be made after the work has been published in the Canada Gazette and two local newspapers, it will be necessary for applicants to re-advertise in the same publications.

Excerpted from:

Aids and Waterways, Navigable Waters Protection Act, Application Guide
Transport Canada, Coast Guard
Supply and Services Canada Cat. No. T 31-38/1980
Document code: TP 2495

4.2 APPLICATIONS UNDER SECTIONS 5(2); 6(4); 9(2)

4.2.1 Exemptions – Section 5(2) of the Act

Section 5(2) of the Act exempts all works (except a bridge, boom, dam, causeway) not considered to substantially interfere with navigation. If you think the work you propose to construct, or have constructed, might come under this exemption, you should submit a letter of application and *ten* copies of the plan showing the nature of the works. (See detachable letter of application). Plan Requirements – (see examples)

(a) Plans of the proposed or "as constructed" work must give sufficient detail (dimensions, cross section of the work), and be drawn to scale, to enable officials of the Canadian Coast Guard to ascertain the effects of the work on navigation.

(b) Site plan is to be provided.

(c) Ten copies of the plan are required (on sheets 210 mm x 297 mm (8¼" x 11¾" minimum).

4.2.2 Navigable Waters Protection Act – Sections 6(4) and 9(2)

Section 6(4) and Section 9(2) of the Navigable Waters Protection Act may be used in processing your application. The applicability of these sections, however, will be determined by officials of the Canadian Coast Guard.

4.3 NATIONAL ENERGY BOARD ACT AND RAILWAY ACT

The Navigable Waters Protection Act does not apply to "Companies", as defined by the National Energy Board Act, R.S.C., 1970, Chapter N-6. Instead, approval to construct pipelines in a navigable water will be granted in accordance with Section 76 of the National Energy Board Act. Railway Companies to which the Railway Act is applicable should follow the procedure set out in Section 189 of the Railway Act, R.S.C. 1970, Chapter R-2.

4.4 INTERIM APPROVAL

Where commencement of construction is urgent, the Minister may, under Section 10 of the Act and paragraph 3(2) of the Navigable Waters Works Regulations, give a limited approval that remains in force while the formalities of the application are proceeding. This approval lapses in six months unless extended by the Minister. A fee of $500 is payable to the Receiver General of Canada for covering the cost of an immediate inspection by officials. Reasons for urgency must be stated in the application letter addressed to the Chief, Navigable Waters Protection Act Programs Division, Canadian Coast Guard, Department of Transport, 6th Floor, Tower "A", Place de Ville, Ottawa, Ontario, K1A 0N7, and a certified cheque payable to the Receiver General of Canada must be included. To expedite your request for interim approval, you may forward five copies of your plans to the address previously mentioned and five copies to the appropriate Regional Office (see geographical locations and address list for the Regional and District offices).